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SELECTION STUDY TO IMPROVE REPRODUCTION PERFORMANCE AND CARCASS QUALITY OF BARBADOS BLACKBELLY SHEEP

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Selection Study To Improve Reproduction Performance And Carcass Quality of Barbados Blackbelly Sheep

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SELECTION STUDY TO IMPROVE REPRODUCTION PERFORMANCE AND CARCASS QUALITY OF BARBADOS BLACKBELLY SHEEP

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INTRODUCTION

The Barbados Blackbelly Sheep (BBS) has been recognized for its high prolificacy for many years. It is considered one of the four leading breeds in the world with high prolificacy, the other three being the Finnish, Landrace, Russian Romanov and Booroola Merino. The BBS is a hair breed of sheep that is reddish brown in color with a black belly and black markings on the mouth, over the eyes, and on the ears. They have a fairly large frame, a nervous temperament, a somewhat sloping rump and a tail that reaches the hock.

Crossbreeding experiments conducted at Greenland, a Barbados Agriculture Station, between 1975 and 1984 produced BBS carcasses that were equal in quality and muscling to BBS X Suffolk and BBS X Dorset crosses (Romans 1979). It was concluded that the carcass quality of the BBS was sufficient for the meat trade and that enough variation existed in carcass quality and quantity and rate of gain to select within the breed rather than to continue with crossbreeding. The flavor of the meat was considered by many to be superior to the British breeds.

The crossbred lambs were less resistant to heat which affected their ability to breed all year around as the Blackbelly does. Wool growth in the F_1s was a problem because no skilled shearers could be found on the island. Due to the mild climate, there is no demand for wool. Many of the crossbred lambs died due to stress.

Growth trials on lambs in confinement conducted by the Ministry of Agriculture in Barbados (Blaylock, 1984) suggested that BBS might produce growth rates comparable to breeds in North America and Europe.

The information derived from carcass evaluation and growth trials led to the development of a confinement/nutrition research project with Blackbelly sheep. A sub-project dealing with selection of animals for the next generation which were superior in growth rate and carcass quality was also implemented. This latter experiment is a collaborative investigation between Lincoln University and The Ministry of Agriculture in Barbados and is being funded by the U.S. Agency for International Development.

MATERIALS AND METHODS

Animals

There are 126 ewes on the experiment rotated every five weeks in groups of 21. For 5 weeks, the ewes are exposed to 3 different rams in groups of 7.

The ewes were brought to Greenland from Sedge Pond and the 3 rams were purchased from a breeder on the island. The ewes were 5 years and older. Five weeks allowed ewe exposure to rams through two estrus cycles. The ewes were in a total confinement barn divided into 17 pens to provide for breeding throughout gestation, lambing, creep feeding and feeding lambs to market weight for slaughter or for replacement breeding stock.

Farm Location

The confinement barn for this experiment (Barbados Blackbelly sheep) is located at Greenland in the Parish of St. Andrew and operated by the Ministry of Agriculture, Food and Consumer Affairs. Patterson (1984) reported higher incidences of respiratory diseases and internal parasite problems because of the wetter area at Greenland, which is in the northeast part of the island.

Breeding Program

The project began June 18, 1985 with the first group of 21 ewes exposed to 3 rams in groups of 7. The ewes remained with the rams for 5 weeks. The 3 rams introduced in the

breeding pen were #2553, #2412, and #2912. Details of the breeding scheme for the first cycle are shown in table 1.

The ewes appeared healthy and the average weights of the ewes at weaning were almost 3 lbs. heavier than when they were first introduced in the pens (table 2). The ewes were cycled again through the breeding pens beginning on January 19, 1986. Ram #2912 had a foot injury and was replaced by ram #3660 and remained with all six groups, second-time breeding. The ewes were rested prior to the third cycle due to lack of recovery. The ewes were mouthed and aged at 5 years and older when first placed in the breeding pens. Many could have been older, resulting in an inability to hold up in confinement. Some ewes were culled and group 2 and 3 were combined to compare with their ewe lambs. Third time around in the breeding pens, ram #2912 was reintroduced. This was important to more accurately compare the lambs of this original mating with the offspring from the lambs born to their offspring.

Feeding Program

Grass hay is fed ad libitum with fresh hay provided early morning at approximately 6:30 a.m. A pelleted ration of 18% crude protein was mixed with molasses and fed at approximately 7:30 a.m. each day. The ewes were weighed to adjust the rations that have been formulated to meet the NRC requirements. These weights are presented in table 2.

The ewes were weighed on the day they entered the breeding pens, in mid-gestation, late-gestation, immediately after lambing and at weaning.

The weight gains of the ewes were within the range predicted from the ration formulation following NRC recommendations.

Creep Feeding

Creep feed was introduced to the lambs at three weeks of age and is an 18% crude protein feed, 2% crude fat, 10% crude fiber, .90% salt, .89% calcium, .78% phosphorus, 100 mg/ton selenium, 4900 IU/kg Vit. A, 980 IU/kg Vit. D, 5 IU/kg Vit. E and 15 gms/ton monensin to

control coccidia and increase feed efficiency. Each group of lambs will be weaned when the last lamb born in that group is 45 days of age.

Selection Program

The lambs were weighed every 28 days and data were entered in the computer (IBM-PC) when the youngest lamb was 45 days of age and the oldest lamb not over 135 days of age. Environmental variation factors that cannot be transmitted in the next generation such as age of ewe, sex of the lamb, type of birth and rearing were adjusted on the computer to provide as equal a genetic base as possible to determine the genetic variation that is transmitted from dam to daughter and son. The lamb's weaning weights were then averaged and the adjusted average was divided into each individual lamb's weight and multiplied by 100. The ewe lambs selected for replacements were those with ratios over 100. Ram lambs selected for breeding in generation 2 were those with the highest weaning weight ratios at 120-day weights.

Internal Parasite Control Program

The ewes are dewormed with a drench solution of oxbendazole (Synanthic), fenbendazole (Panacur), mebendazole (Ovitelmin) and rotated to decrease worm resistance to the anthelmintic. Following the initial deworming, fecal samples are collected and analyzed and dewormers are administered in the pens that had a moderate to high egg count. Coccidia are controlled by adding 15gm/ton of Monensin to all formulated feeds.

Carcass Evaluation Program

Lambs were selected at random out of the 3 rams following the selection of breeding replacement. They were slaughtered at the Barbados Central Abattoir. They were evaluated for dressing percent, loineye area at 12th rib, backfat a 12th rib, kidney-pelvic fat, quality leg score and yield grade.

Ultrasound Program

Loineye measurements were determined by drawing the loineye on transparent paper and

applying a planimeter for the actual measurement. Backfat was an average measurement of 3 areas taken at the 12th rib.

Heart, kidney, pelvic (H.K.P.) fat was weighed following removal from the carcass.

A 7% shrink was calculated from previous work of slaughtered lambs from Greenland taken to the Barbados Central Abattoir.

Leg confirmation score was a subjective evaluation.

Sensory Panel Lamb Carcass Evaluation Program

An eight-member trained sensory panel evaluated twenty-four carcasses of Blackbelly lamb at day 1 and day 5 post-slaughter. New Zealand frozen lamb was compared for tenderness, juiciness and acceptability.

The dorsal portion of the semi-membranosus muscle was cut in lean 1" thick portions. The longissimus muscle was also cut 1" thick prior to cooking. The meat was cooked in a 350 degree F pre-heated oven to an internal temperature of 158 degree F and allowed to temper for 3 minutes in a 200 degree F oven with the door open.

The edges of the samples were stet trimmed of any browned portions of lean and 1/4" strips approximately 1" long were served to the trained sensory panel. Each panel member tested the sample without swallowing the sample and consumed bread wedges to remove flavor remnants of previous samples. A maximum of seven samples were served at any one sitting.

The score sheets used were developed by the University of Missouri Food Science and Nutrition Department. Each panel member scored each sample by marking a verticle line across a 10 cm. line. The distance from left to right was measured for an absolute value by laying a ruler under the line to the nearest millimeter for statistical analysis.

Warner-Bratzler Shear Program

Twenty-four Blackbelly lamb carcasses were evaluated for tenderness using the Warner-Bratzler shear device on day 1 and day 5. Thirteen samples of New Zealand lamb were

evaluated. The longissimus and semi-membranosus muscle of the Blackbelly and New Zealand lamb were cut in one inch thick portions and cooked in a 350 degree F preheated oven to an internal temperature of 158 degree F. The samples were then allowed to temper for 3 minutes in a 200 degree F oven with the door open.

Core samples of one-half inch were taken at three locations of dorsal, medial and ventral areas. Three samples of the dorsal, medial and ventral core samples were evaluated on the Warner-Bratzler shear. The Blackbelly samples were evaluated at 1-day and 5-day post-slaughter aging in a refrigerator at 4 degree C. The New Zealand lamb was thawed in the refrigerator and then evaluated. The Warner-Bratzler shear measured pounds of pressure required to cut through the one-half inch samples of longissimus and semi-membranosus muscle.

TABLE 1
BREEDING SCHEME

	DATES		RAM ID #		
CYCLE #1	IN	OUT	#2553	#2412	#2912
GROUP #1	06-18-85	07-22-85	7 EWES	7 EWES	7 EWES
GROUP #2	07-22-85	08-26-85	7 EWES	7 EWES	7 EWES
GROUP #3	08-26-85	08-26-85	7 EWES	7 EWES	7 EWES
GROUP #4	09-16-85	10-21-85	7 EWES	7 EWES	7 EWES
GROUP #5	10-21-85	11-18-85	7 EWES	7 EWES	7 EWES
GROUP #6	11-18-85	12-23-85	7 EWES	7 EWES	7 EWES
CYCLE #2			#2553	#2412	#3660
GROUP #1	01-19-86	02-26-86	7 EWES	7 EWES	7 EWES
GROUP #2	02-26-86	03-28-86	7 EWES	7 EWES	7 EWES
GROUP #3	02-28-86	04-28-86	7 EWES	7 EWES	7 EWES
GROUP #4	04-28-86	06-02-86	7 EWES	7 EWES	7 EWES
GROUP #5	06-02-86	07-07-86	7 EWES	7 EWES	7 EWES
GROUP #6	07-07-86	08-25-86	7 EWES	7 EWES	7 EWES
CYCLE #3			#2553	#2412	#2912
GROUP #1	08-25-86	10-05-86	7 EWES	7 EWES	7 EWES
GROUP #2	11-18-86	12-23-86	7 EWES	7 EWES	7 EWES
GROUP #3	12-23-86	01-30-87	7 EWES	7 EWES	7 EWES

YIELD GRADE

The equation for determining yield grade is:

Yield Grade = 1.66 - (0.05 X leg conformation grade)
+ (0.25 X percent kidney and pelvic fat)
+ (6.66 X adjusted fat thickness over the loineye in inches)

The yield grade combines the measurements of leg conformation grade, kidney and pelvic fat and loineye in an equation to predict the percent boneless retail yield of lean, from the

boneless, closely trimmed, major retail cuts. Yield grade 1 represents the highest yield of retail cuts and yield grade 5 represents the lowest. Factors that determine the yield grade are:

1. External fat over the loineye.
2. Kidney and pelvic fat.
3. Leg confirmation grade.

The amount of external fat determined from the measurement over the loineye has the most influence on yield grade, amount of kidney and pelvic fat is intermediate and the leg confirmation grade is least in importance.

QUALITY GRADE

Grades		Quality Leg Score	Grades		Quality Leg Score
P+	High Prime	15	G+	High Good	9
P	Avg. Prime	14	G	Avg. Good	8
P-	Low Prime	13	G-	Low Good	7
CH+	High Choice	12	V+	High Utility	6
CH	Avg. Choice	11	V	Avg. Utility	5
CH-	Low Choice	10	V-	Low Utility	4

Firmness of Lean and Fullness and Firmness of Flank		Fat streaking in the Flank	
TF:	Tending to be firm	SLA:	Slightly abundant
MF:	Moderately firm	Md:	Moderate
TMF:	Tending to be moderately firm	Mt:	Modest
SF:	Slightly firm	Sm:	Small
TSF:	Tending to be slightly firm	SL:	Slight
STS:	Slightly thin and soft	T:	Traces
		PP:	Practically void

The quality and yield grades, loineye, backfat, liveweight, carcass weight, 7% shrink, and percent retail yield are shown in table 1. Carcasses were evaluated out of 3 rams, #2553, #2412 and #2912.

Ultrasound Measurements

Ram and ewe lambs retained for breeding were measured for loineye and backfat with ultrasound (ithaco Scanoprobe).

Loineye measurements were considered in the replacement breeding ewe and ram lambs.

RESULTS AND DISCUSSION

Ewe Production Data

Of the 126 ewes exposed to rams the first breeding season, 13 ewes lambed too early, suggesting they were pasture bred before they were put into the breeding pens. Ninety-three percent of the ewes exposed lambed with a lambing rate of 234% (table 2). The percentage of lambs weaned of the lambs born was 72% with a high death rate of 57.7% recorded as stillbirths. The weaning rate was 169%. The percentage of lambs weaned of the number born was 86.3%.

On an annual basis, the Blackbelly ewes produced 5.25 lambs per ewe and lambed every 7.7 months.

A comparision of the original breeding stock bred at the same time as the first generation of selected replacement ewes and rams resulted in a twelve pound increase adjusted 90-day weight and a fifteen pound increase in the grand-offspring at 120 days of age. Selection for increased weaning weight was very effective as shown by the increase in total pounds of meat.

TABLE 2
EWE PRODUCTION DATA

Group	Number of ewes open at introduction of ram	No. of ewes lambed	No. of lambs born**	No. of lamb weaned
1	18*	17	37	28
2	20	17	39	28
3	21	19	49	33
4	21	21	52	34
5	12*	10	25	13
6	21	21	44	41
TOTAL	113	105	246	177

*Thirteen (13) ewes lambed too early, suggesting they were bred before being put into the breeding pens.

Lambing percentages 1 - 92.9%
Lambing rate 2 - 234%

Weaning percentage	3 - 72%
Survival Rate	4 - 86.3%
Weaning rate	5 - 169%

**57.5% of all deaths were recorded as "stillbirths."

1. Lambing Percentage - No. of ewes lambing expressed as a percentage of the number of ewes exposed to the ram.

2. Lambing Rate - No. of lambs born expressed as a percentage of number of ewes which lambed.

3. Weaning Percentage - No. of lambs weaned expressed as a percentage of number of lambs born.

4. Survival Rate - No. of lambs weaned expressed as a percentage of number of lambs born alive.

5. Weaning Rate - No. of lambs weaned expressed as a percentage of number of ewes that lambed.

The ewes in group 1-6 were 90.99 lbs. at the beginning of the project. At mid-gestation, they weighted 94.11 lbs. and at late gestation, 107.80 lbs. The ewes were weighed following the birth of the lambs and were heavier than when put in a breeding pen with average weight of 97.24 lbs. At weaning they had maintained weight throughout lactation, average weight, 93.39 lbs. (table 3).

TABLE 3
EWE WEIGHT
Average weight (lbs)

Group	Beginning of Project	Mid-Gestation	Late Gestation	Birth of Lambs	At Weaning
1	87.34	95.29	109.39	89.66	95.08
2	85.10	92.05	101.56	91.68	91.20
3	74.10	95.62	111.97	99.75	95.16
4	97.34	94.0	105.57	102.14	87.20
5	87.33	91.09	105.26	101.47	100.67
6	94.73	96.60	113.04	98.76	91.05
Average	90.99	94.11	107.80	97.24	93.39

Birth Weights

Birth weights of lambs in groups 1 through 6 averages 6.49 lbs. with an average minimum weight of 3.62 lbs. and maximum weight of 10.25 lbs. (table 4). These weights are lower than birth weights in British breeds of sheep. British breeds birth weights averaged 8-12 pounds.

TABLE 4
BIRTH WEIGHTS
Average weights (lbs)

Ewe Group	Average	Minimum	Maximum
1	6.73	4.5	11.0
2	6.32	3.5	10.0
3	6.07	2.5	11.0
4	6.44	3.75	9.5
5	7.0	4.0	11.0
6	6.36	3.5	9.0
Average	6.49	3.62	10.25

Lamb mortality was decreased when the sheep barn at Greenland was wired for lighting. Keeping the lights on during the night allowed the ewes to see the lambs and resulted in fewer lamb losses. There was no marked difference in the average weight of lambs in groups 1 through 6 even though they were born at different times throughout the year. Larger litters resulted in smaller lamb weights and fewer lambs surviving.

Average 60-90-120 Weight Per Day of Age

There was a marked difference in the 60-day adjusted weight of lambs in the six groups. The range of the average 60-day adjusted weight was 26.19 lbs. to 37.72 lbs. (table 5). This was due in part to management. The ewes in group 4 were somewhat overcrowded and they were brought over from Sedge Pond in order to have enough numbers for the experiment. Milk production in the ewes was variable as would be expected and gains

of lambs were reflected from this variable. The heritability estimate of 60-day weaning weight is 25-30% due to heredity and 70-75% variation due to environment which is primarily milk production in this experiment since we have taken out the environmental differences due to age of the dam, sex of the lamb and type of birth and rearing (table 8).

The 90-day adjusted weight on feed that is on an equal basis in the pens increases the variation due to inheritance and lowers the variation due to the environmental difference of feed consumption. The heritability estimate for 90-day adjustment weight is 30-35%. It increases in the 120-day adjusted weight to 35-40% with the variation observed at this age increasingly due to the genetic differences observed compared to the environmental differences.

The average daily gains remained fairly consistent for the groups in the 60 to 120-day adjusted weights, as shown in table 5. These results show reliable results on the average when selecting at 60-day adjusted weight even though there were several individual weight gains within the groups that increased more rapidly than the average and some individual lambs that gained less reflecting increases and decreases in the weaning weight ratios.

TABLE 5
WEIGHT PER DAY OF AGE

Ewes	60-day adj. wt. (lbs.)	90-day Adj. wt. (lbs.)	120-day Adj. Wt. (lbs.)
Group 1	32.6	53.47	73.42
Group 2	34.9	50.82	71.48
Group 3	30.38	48.66	66.55
Group 4	26.19	40.99	53.89
Group 5	37.72	55.96	73.09
Group 6	30.58	44.05	56.76
Average	32.06	48.99	65.86

Postweaning Growth Rate

The lambs in group 1 were on feed for 154 days and in group 2 for 124 days. The ram lambs, as expected, outgained the ewe lambs in both groups, but the difference was greater in group 2 which may have been an age factor. There was no significant difference in gains in the two groups.

Post weaning growth rate of groups 1 and 2 was .55 lbs/day and .59 lbs/day for ram lambs, respectively. Ewe lambs average daily gains were less at .42 lbs/day for group 1 and .44 lbs/day for group 2 (table 6).

TABLE 6
GROWTH RATE DATA

	Group I		Group II	
	Ram Lambs	Ewe Lambs	Ram Lambs	Ewe Lambs
No. of Animals	14	14	10	17
Initial Weight	31.02	26.18	37.18	29.04
Final Weight	115.72	90.86	110.44	84.48
Total Gain	84.7	62.7	73.26	55.44
Days on Feed	154	154	124	124
Avg. Daily Gain (lb/day)	0.55	0.42	0.59	0.44

Ram Lamb Selection

Selection of replacement rams was aided by the computer based program written in BASIC language for the IBM-PC.

Using the computer program data based on weight per day of age (WDOA) each lamb was adjusted for environmental variation of age of dam, sex of lambs, type of birth, and rearing. The values for adjustments were taken from the 1986 National Sheep Extension Committee Report (table 8). Six rams were selected for further evaluation.

Following selection, based on the adjusted 120-day weight ratios, the rams were evaluated for breeding soundness, using testicular palpation, and measurements of scrotal circumference.

Ultrasound measurements of backfat and loineye area at 12th rib, shoulder height and Blackbelly breed characteristics were also considered. Three ram lambs were subsequently selected (3412, 3407, 3445) with measurements listed in table 7. Two additional ram lambs were retained as back-up rams, 3427 and 3593.

Three of the five rams selected were from sire #2553. To avoid inbreeding, one of the rams was selected out of ram #2912 that was inferior to a ram out of #2553 (table 7). Ram #3412 was superior in weight, height, scrotal circumference and scanoprobe loineye measurements (table 7). The difference in weight ranged from 125 to 155 lbs., length from 29.1 to 31 inches, and height from 29.5 to 33 inches (table 7). Backfat measurements were the same for all five rams with measurement taken with the scanoprobe. The scrotal circumference was surprisingly small compared to British breeds of sheep, especially, when testicular measurements and prolificacy are positively correlated having the prolificacy observed in the ewes. The loineye area measured in square inches was greater in ram #3412 measuring 2.97 square inches with the remaining rams measuring 2.64 square inches.

The average weight of the three ram lambs selected to mate in the next generation, #3412, #3407 and #3445 averaged 144 lbs. The average weight of the rams siring these rams at the beginning of the project was 129 lbs. The difference in the sires and their offspring may be due to nutritional differences rather than genetic differences. The original sires, #2553, #2912 and #2412 increased in five weeks, no doubt, due to the increased energy provided in the diet in the breeding pens. At the time the three rams were introduced in the breeding pens in November, their weights were 170, 175 and 145 lbs. for 3407, 3412 and 3445, respectively.

Investigations in August, 1986 indicated the loineye area could be estimated very accurately by measuring the loin muscle depth at 1 1/2 inches lateral to midline and vertically using ultrasound. The depth of ventral side of loin muscle less the thickness of the skin and fat times the constant of 1.65 equals the loineye area in square inches. The average error on sixteen

carcasses was .118 square inches.

TABLE 7
RAM LAMB SELECTION

RAM ID	SIRE ID	WT. (lb.)	LENGTH (in.)	HEIGHT (in.)	BACKFAT (in.)	SCROTAL CIR. (cm.)	SCANO PROBE LOIN (sq. in.)
7086 - 3412	2553	155	30.0	31.5	.1	31.75	2.97
7087 - 3407	2412	145	31	33	.1	26.67	2.64
7084 - 3445	2912	133	30.5	29.5	.1	30.73	2.64
7112 - 3427*	2553	140	30.0	32	.1	27.94	2.64
7113 - 3593*	2553	125	29.1	30.3	.1	26.04	2.64

*Back up rams retained for use if injuries or reproductive problems arise.

TABLE 8
WEIGHT ADJUSTMENT FACTORS

	Age of dam (years)		
	3 to 6	2 or over 6	1
Ewe Lamb			
Single	1.00	1.09	1.22
Twin - raised as twin	1.11	1.20	1.22
Twin - raised as single	1.05	1.14	1.28
Triplet - rasied as triplet	1.22	1.33	1.46
Triplet - raised as twin	1.17	1.28	1.42
Triplet - raised at single	1.11	1.21	1.36
Wether			
Single	0.97	1.06	1.19
Twin - raised as twin	1.08	1.17	1.30
Twin - raised as single	1.02	1.11	1.30
Triplet - raised as triplet	1.19	1.30	1.25
Triplet - raised as twin	1.14	1.25	1.39
Triplet - raised as single	1.08	1.18	1.33
Ram Lamb			
Single	0.89	0.98	1.11
Twin - raised as twin	1.00	1.03	1.22
Twin - raised as single	0.94	1.03	1.17
Triplet - raised as triplet	1.11	1.22	1.35
Triplet - raised as twin	1.06	1.17	1.31
Triplet - raised as single	1.00	1.10	1.25

Source: 1968 National Sheep Extension Committee Report, "Recommendations for Uniform Sheep Selection Programs.

Ewe Lamb Selection

The computer based sheep program record of adjusted 120-day weight per day of age ratios were used for the selection of replacement ewe lambs. The ewe lambs with ratios over 100 were selected for the lambs to be produced in the second generation. The ratios of 100 represents the average of all lamb weights and those ewe lambs above 100 are those performing above average in the group in which they were raised. The ewe lambs were selected from group 1

through 4. They were put in the breeding pens November 11, 1986 ranging in age from 7 months to 11.5 months of age. Group 2 and 3 ewes were placed in the breeding pens at the same time as the ewe lambs with the original rams so that performance of the selected ewe and ram lambs could be measured and compared with group 2 ewes and rams randomly selected at the beginning of the project.

To avoid inbreeding, the selected ewe lambs were mated to rams that were unrelated. The largest number of ewe lambs selected from the program were sired by ram #2553. The highest ratios in the ram lambs were those lambs sired by #2553. This presented a problem in the program that resulted in one ram assigned to a ewe lamb breeding group that was of lesser quality in weight, height and length out of #2912 in order to avoid inbreeding.

The ewe lambs assignment in the breeding pens in listed in table 9. Seven ewe lambs were assigned to each ram in 3 breeding pens totalling 21 ewe lambs.

The ewe lambs selected are heavier than the dams in group 1 when put in the breeding pens. Group 1 and 2 ewes averaged 88 lbs and the ewe lambs selected averaged 94 lbs (table 10). The ewe lambs have not reached mature size and should continue to grow during gestation, lactation and may need a recovery period before re-breeding to allow them some time to grow, otherwise, they may not reach the potential full mature size. The mature ewes that were put in the breeding pens were estimated at 5 years of age or older and were fully matured. This is not to say that they might have been larger given the nutritional level the ewe lambs received in this confinement system which is considered optimal.

Effects of selection was measured in July of 1987. Weaning weights and carcass quality of lambs born to the 21 replacement ewe lambs and 3 ram lambs was compared to the original 21 ewes and 3 rams in group 2 to determine the results of selection..

TABLE 9
EWE LAMB SELECTION

Group #7

3407 - 7087				3445 - 7084				3412 - 7086			
Lamb Id.	Sire	Wt. lbs	Scano Probe Loin (sq. in.)	Lamb Id.	Sire	Wt. lbs	Scano Probe Loin (sq. in.)	Lamb Id.	Sire	Wt. lbs	Scano Probe Loin (sq. in.)
7095-3417	2912	99	1.65	7083-3405	2553	102	1.50	7093-3422	2412	91	1.65
7088-3416	2912	98	1.50	7090-3406	2553	98	1.98	7078-3423	2412	83	1.81
7089-3416	2912	92	1.65	7080-3419	2553	92	1.32	7091-3456	2412	97	1.50
7096-3535	2912	90	1.32	7085-3531	2553	102	1.32	7079-3465	2412	86	1.32
7098-3671	2553	89	1.81	7092-3581	2553	90	1.65	7081-3466	2412	84	1.81
7094-3520	2553	87	1.50	7100-3692	2553	107	2.15	7082-3508	2412	83	1.81
7099-3614	2553	89	1.65	7077-3574	2553	75	1.98	7097-3615	2412	101	1.81

TABLE 10
COMPARATIVE GROUPS

Group 2 & 3	IN	OUT			IN	OUT	
		11-18-86	12-23-86			11-18-86	12-23-86
Ewe ID	Sire ID	Wt. lbs.	Wt. lbs.	Ewe Lamb ID	Sire ID	Wt. lbs.	Wt. lbs.
7101-2905	2553	105	106	7093-3422	3412	96	98
7107-2045	" "	84	96	7078-3423	" "	84	93
7115-2049	" "	90	103	7091-3456	" "	103	106
7119-2010	" "	85	99	7079-3415	" "	93	105
7120-3697	" "	96	lambed early	7081-3466	" "	85	93
7121-2028	" "	95	106	7082-3508	" "	85	89
7122-2937	" "	83	96	7097-3615	" "	104	11
7103-3613	2412	84	98	7095-3417	3407	94	102
7109-2399	" "	85	98	7088-3416	" "	97	102
7110-2026	" "	90	107	7089-3592	" "	97	101
7114-2014	" "	84	103	7075-3536	" "	83	88
7116-2409	" "	86	101	7098-3671	" "	96	99
7117-2058	" "	87	103	7094-3520	" "	86	93
7118-2057	" "	86	99	7099-3614	" "	90	95
7102-1446	2912	90	113	7083-3405	3445	102	110
7104-3798	" "	88	103	7090-3406	" "	102	104
7105- 852	" "	80	91	7080-3419	" "	94	101
7106-3699	" "	95	121	7058-3531	" "	107	104
7108-1405	" "	95	108	7092-3581	" "	96	105
7123-1868	" "	80	91	7100-3692	" "	106	116
7124-2008	" "	82	99	7077-3574	" "	79	87
Average		88	102	Average		94	100

Carcass Evaluation

Thirty-six carcasses were evaluated by Maurice Alexander, state extension meat specialist. Live weight and carcass weight of lambs sired by #2553 was heavier than lambs sired by #2912 and #2412 (table 11). Live weights, in pounds, of lambs were 114.7, 108.9 and 103.6 from sires

#2553, #2912 and #2412. Carcass weights, in pounds, were 55.7, 52.7 and 50.3 from sires #2553, #2912 and #2412, respectively (table 12). Sixteen carcasses were evaluated from ram #2553. Ten carcasses were slaughtered and evaluated from ram #2912 and ram #2412.

More lambs were born and survived from ram #2553 and more lambs were selected for replacement rams and ewes. Three of the five rams and ten of the twenty-one ewe lambs selected were sired by #2553. These were to produce lambs in the next generation.

TABLE 11

CARCASS DATA SUMMARY

ID	Live Wt. (lbs)	7% Shrink (lbs)	Carcass Wt. (lbs)	Dressing %	Adj. LEA sq. in.	Backfat in.	H.P.K. %	Leg. Conf. Score	Yield Score	Total Score	Quality Grade
2553 n=16	114.7	107	55.7	52.3	2.18	.12	3.12	11.7	2.7	46.0	11.37
2912 n=10	108.9	101	52.7	52.2	2.00	.12	3.47	11.4	2.4	46.2	11.0
2412 n=10	103.6	96	50.3	51.7	2.05	.095	3.10	10.8	2.5	46.3	10.6

Warner-Bratzler Shear Evaluation

The semi-membranosus muscle in each Blackbelly lamb sample was measured with three cores taken at the dorsal, medial and ventral areas. The cores were cut three times on the Warner-Bratzler shear resulting in nine per sample. The average pounds required to the cut serni-membranosus sample on day 1 was 16.33 lbs. and day 5, 9.48 lbs. The New Zealand lamb semi-membranosus muscle required an average 13.3 lbs. pressure.

The longissimus muscle was measured the same way as the semi-membranosus muscle. The day 1 samples were 14.81 lbs. pressure and day 5, 8.88 lbs. The thirteen samples of New Zealand lamb average 7.05 lbs.

Statistical analysis of the effects of aging on tenderness at day 5 of Blackbelly semi-membranosus muscle was greater than New Zealand lamb(9.48 lbs. vs. 13.3 lbs) $P<.001$). No differences in tenderness were observed in the Blackbelly semi-membranosus muscle at day 1 and New Zealand frozen lamb (16.33 lbs. vs. 13.3 lbs). Aging of the Blackbelly longissimus muscle to day 5 resulted in less tenderness than the New Zealand lamb ($P<.05$), (8.88 vs. 7.05 lbs).

This study showed aging Blackbelly lamb to day 5 provided a carcass acceptable in tenderness for the meat trade in Barbados (Figure 1-6).

Sensory Panel Evaluation

The eight-member sensory panel evaluated the lamb as desirable-undesirable flavor, dry-juicy and tough-tender on a scale of one to ten cm. on day 1 and day 5. New Zealand Lamb was compared with the day 1 and day 5 Blackbelly lamb. The longissimus and semimembranosus mucle were compared at day 1 and day 5. Both muscle were more desirable in flavor, juiciness and tenderness following 5 days of aging.

Day 1 longissimus muscle of Blackbelly and New Zealand lamb were compared. There was no significance in flavor, however, the New Zealand lamb was juicier and more tender. On day 5 aging of Blackbelly lamb compared with New Zealand lamb, the Blackbelly lamb was more desirable in flavor but there was no significant difference in juiciness and tenderness.

The semimembranosus muscle of Blackbelly and New Zealand lamb at day 1 showed a decided difference in flavor of New Zealand lamb for flavor, juicines and tenderness. At day 5, no significant difference was observed in flavor, juiciness or tenderness of New Zealand compared to Blackbelly lamb (semimembranosus muscle).

These data show that aging Blackbelly lamb to day 5 increases flavor, juiciness and tenderness. This data agrees with the tenderness evaluation taken on the Warner-Bratzler shear.

TABLE 12

CARCASS DATA

Ram ID #2553

ID	Live Wt. (lbs)	% Shrink (lbs)	Carcass Wt. (lbs)	Dressing %	Adj. LEA sq. in.	Backfat in.	H.P.K. %	Leg Conf. Score	Yield Score	Total Score	Quality Grade
3404	132	123	65.5	53.3	2.6	.15	3.25	14	2.8	45.8	P- 13
3403	138	128	68.5	53.5	2.37	.2	2.25	13	2.8	45.8	C- 12
3413	132	123	66.0	53.7	1.49	.1	2.67	12	2.2	46.9	C 11
3519	97	90	50.2	55.7	1.76	.1	3.70	10	2.7	46.0	C 11
2522	78	73	39.4	53.9	2.01	.05	3.40	11	2.3	46.7	C- 10
3526	98	91	52.1	57.3	2.33	.15	3.40	11	3.0	45.4	C+ 12
3480	106	99	55.7	56.2	1.75	.1	5.50	11	3.2	45.2	C+ 12
3568	121	113	55.3	49.0	2.15	.1	2.50	11	2.4	46.5	C- 10
3452	147	137	74.1	54.0	2.91	.2	4.20	13	3.4	44.7	C 11
3567	110	102	46.6	45.7	2.26	.1	1.89	11	2.2	46.9	C 11
3563	95	88	49.3	56.0	2.39	.1	2.23	11	2.5	46.0	C 11
3555	122	114	55.2	50.2	2.15	.1	2.3	11	2.4	46.5	C+ 12
3524	118	110	53.8	48.9	2.16	.2	3.1	13	3.1	45.3	P- 13
3573	120	112	55.0	49.1	2.26	.1	2.4	12	2.3	47.1	C+ 12
3582	115	107	54.8	51.2	2.26	.1	3.2	13	2.5	46.0	C 11
3565	107	100	50.2	50.2	2.37	.1	4.0	10	2.8	45.8	C- 10
n=16	$\bar{X}$=114.7	$\bar{X}$=107	$\bar{X}$=55.7	$\bar{X}$=52.3	$\bar{X}$=2.18	$\bar{X}$=.12	$\bar{X}$=3.12	$\bar{X}$=11.7	$\bar{X}$=2.7	$\bar{X}$=46.0	$\bar{X}$=11.37

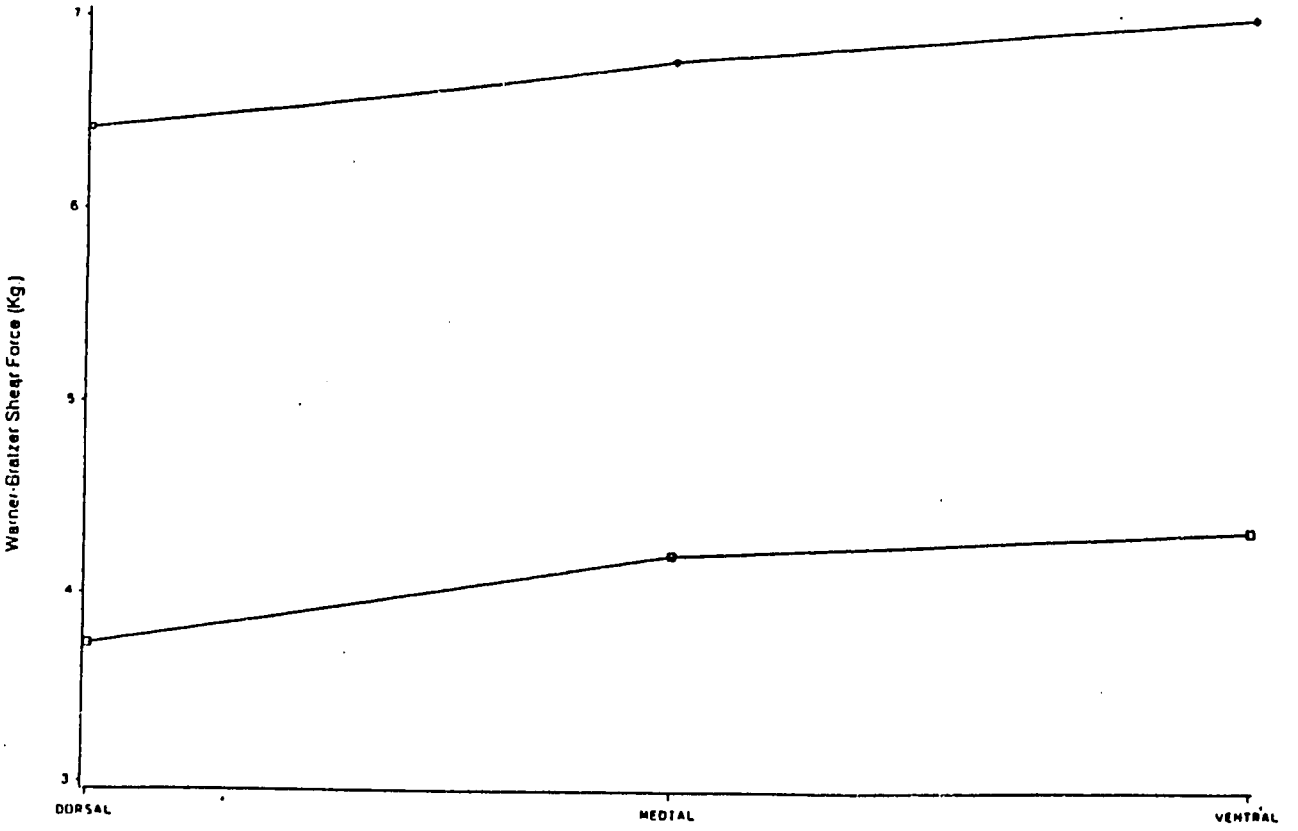
Ram ID #2912

3402	140	130	66.6	51.2	2.10	.2	3.95	13	2.7	45.6	C- 12
3421	110	102	53.1	52.1	2.40	.1	2.07	13	1.8	47.6	G+ 9
3401	125	116	58.5	51.3	1.30	.2	2.58	11	1.3	46.3	C 11
3495	98	91.1	48.8	53.6	1.68	.05	4.1	12	2.4	46.5	C- 10
3512	95	88.4	46.4	52.8	2.40	.1	2.8	10	2.6	46.2	C- 12
3503	89	83	43.8	52.7	2.12	.1	3.3	11	2.6	46.2	C 11
3489	106	99	51.9	52.4	1.70	.1	4.7	10	3.0	45.4	P- 13
3572	122	114	60.3	52.9	2.12	.1	3.85	12	2.7	46.0	C+ 12
3540	111	103	53.2	51.7	1.95	.1	4.13	11	2.8	45.8	C- 10
3571	93	87	44.6	51.2	2.25	.1	3.23	11	2.6	46.2	C- 10
n=10	$\bar{X}$=108.9	$\bar{X}$=101	$\bar{X}$=52.7	$\bar{X}$=52.2	$\bar{X}$=2.00	$\bar{X}$=.12	[illegible]	$\bar{X}$=11.0	$\bar{X}$=2.4	$\bar{X}$=46.2	$\bar{X}$=11.0

Ram ID #2412

3462	125	116	68.8	59.3	2.56	.1	2.91	10	2.5	46.3	C- 10
3506	107	99	52.1	52.6	2.26	.1	2.11	13	2.2	46.9	C- 10
3507	106	98	49.1	50.1	2.02	.2	2.2	10	3.0	45.4	C- 12
3515	92	86	46.2	53.7	1.36	.1	2.9	9	2.6	46.2	C 11
3505	103	96	51.3	53.4	2.08	.1	2.9	11	2.5	46.3	C- 12
3552	75	70	34.8	49.7	2.37	.05	2.8	10	2.2	46.9	G- 9
3528	85	79	38.5	48.7	1.93	.05	3.4	12	2.3	46.7	C- 10
3534	124	115	57.2	47.7	2.23	.1	4.2	13	2.7	46.0	C+ 12
3585	116	108	58.7	54.3	1.98	.1	4.5	12	2.9	45.6	C- 12
3689	103	96	45.9	47.8	1.72	.05	3.1	8	2.4	46.5	G 9
n=10	$\bar{X}$=103.6	$\bar{X}$=96.3	$\bar{X}$=50.3	$\bar{X}$=51.7	$\bar{X}$=2.05	$\bar{X}$=.095	$\bar{X}$=3.1	$\bar{X}$=10.8	$\bar{X}$=2.5	$\bar{X}$=46.3	$\bar{X}$=10.6

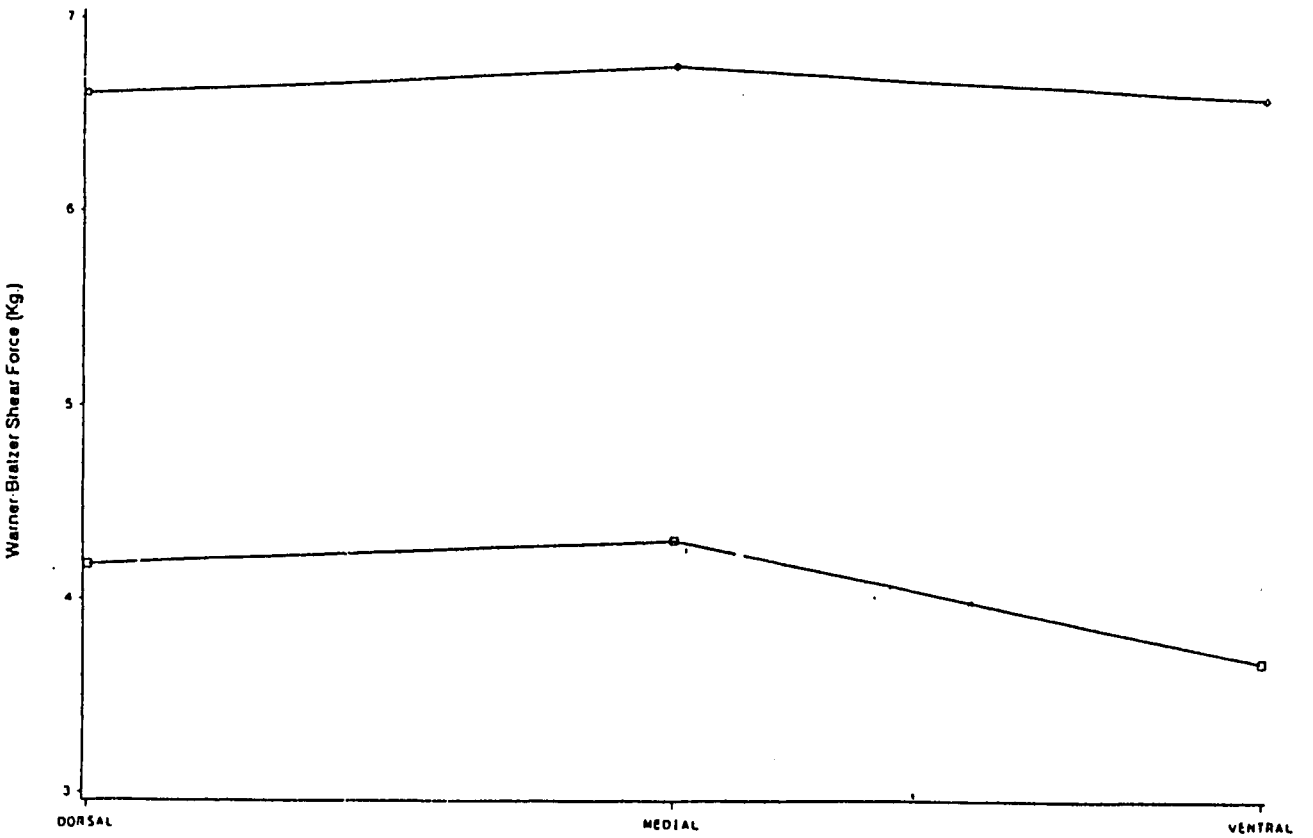
FIGURE 1 BLACKBELLY LAMB - LONGISSIMUS MUSCLE



P<.01

LEGEND DIAMOND --> DAY 1 SQUARE --> DAY5

FIGURE 2 BLACKBELLY LAMB - SEMIMEMBRANOSUS MUSCLE



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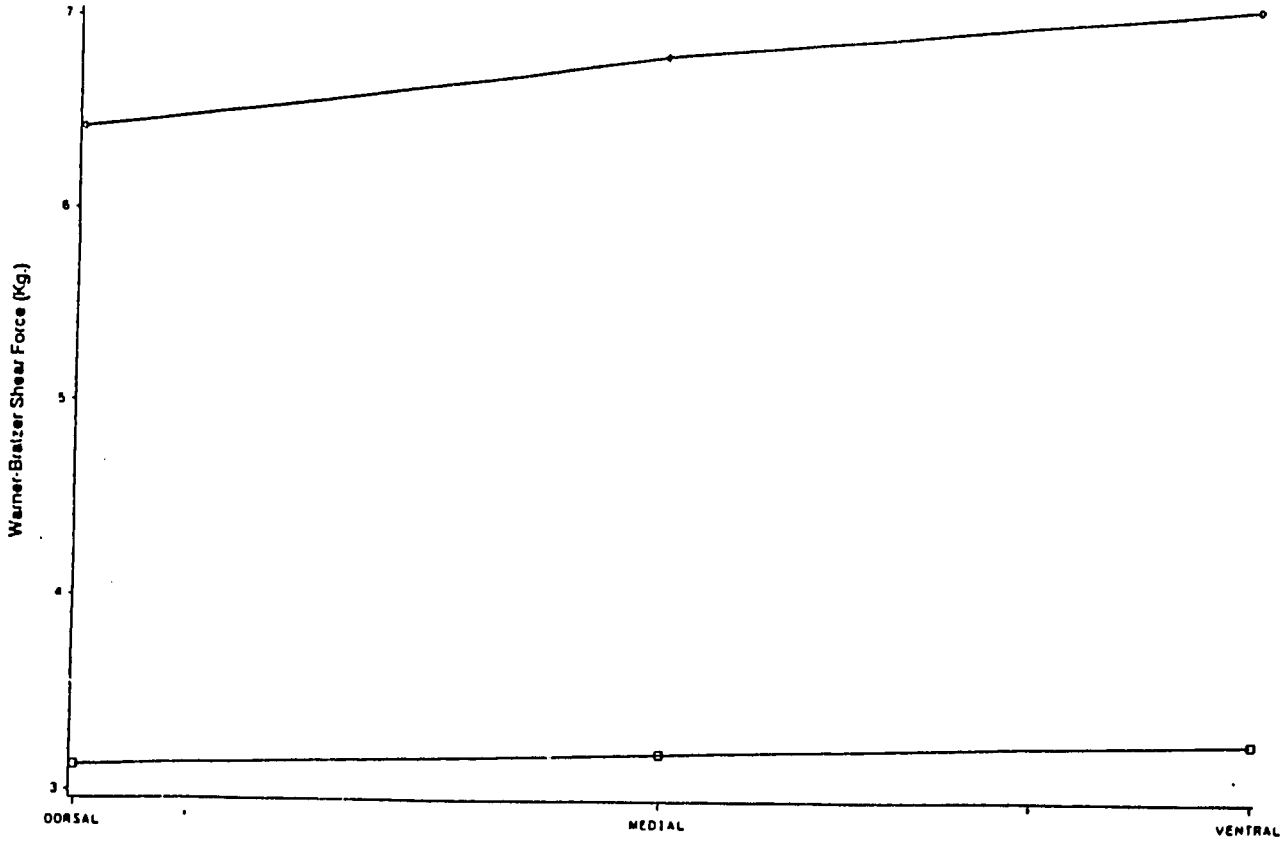
LEGEND DIAMOND --> DAY1 SQUARE --> DAY5

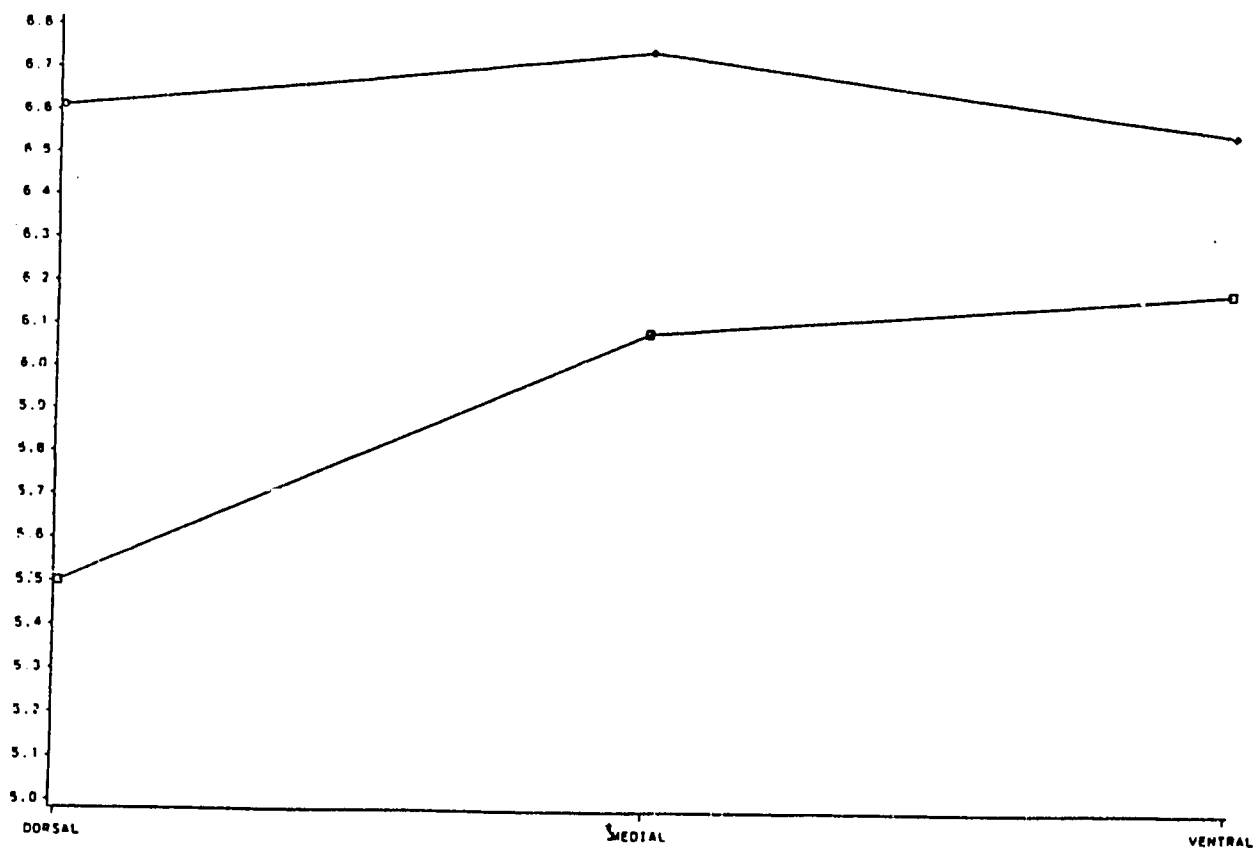
FIGURE 3 BLACKBELLY LAMB – NEW ZEALAND LAMB LONGISSIMUS MUSCLE



P<.01

LEGEND DIAMOND --> BLACKBELLY LAMB SQUARE --> NEWZEALAND LAMB Day 1

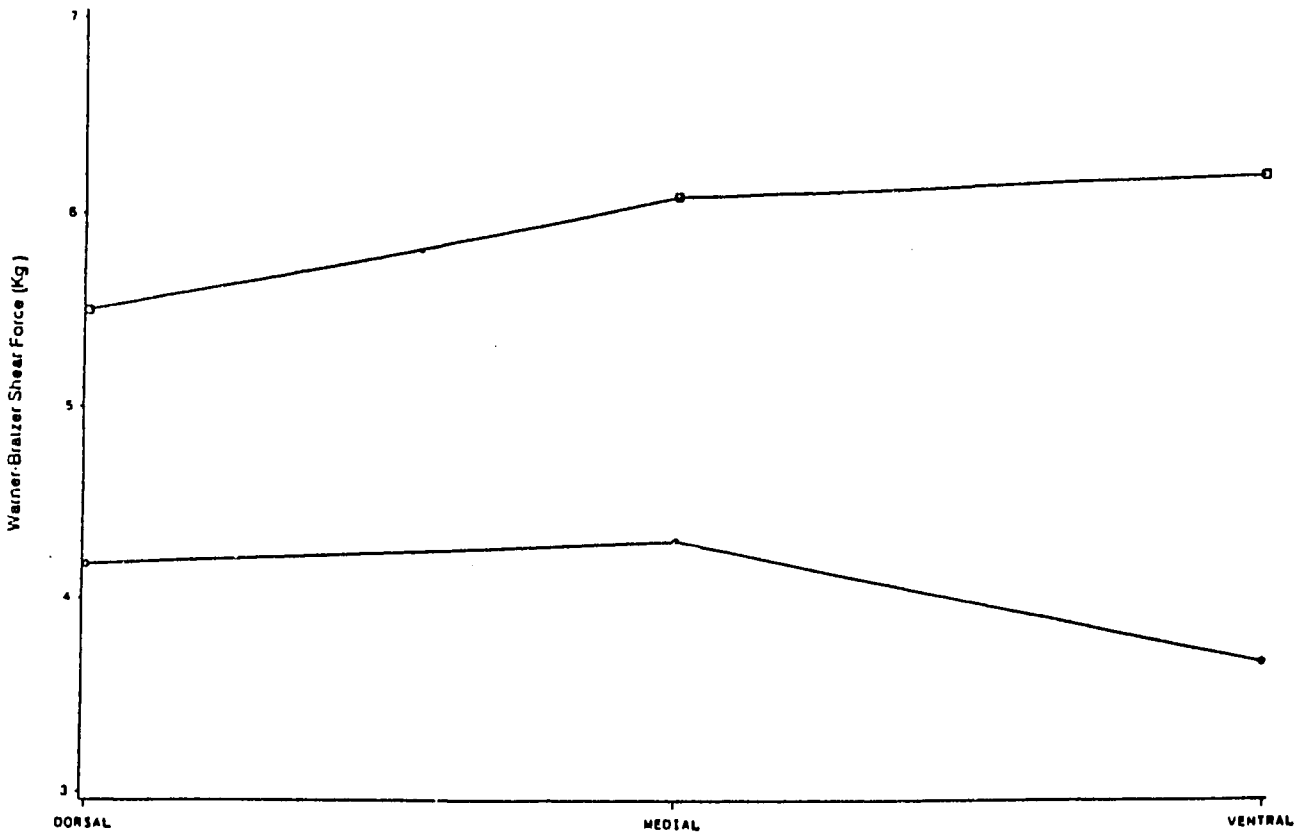
FIGURE 4 BLACKBELLY LAMB – NEW ZEALAND LAMB SEMIMEMBRANOSUS MUSCLE



NS

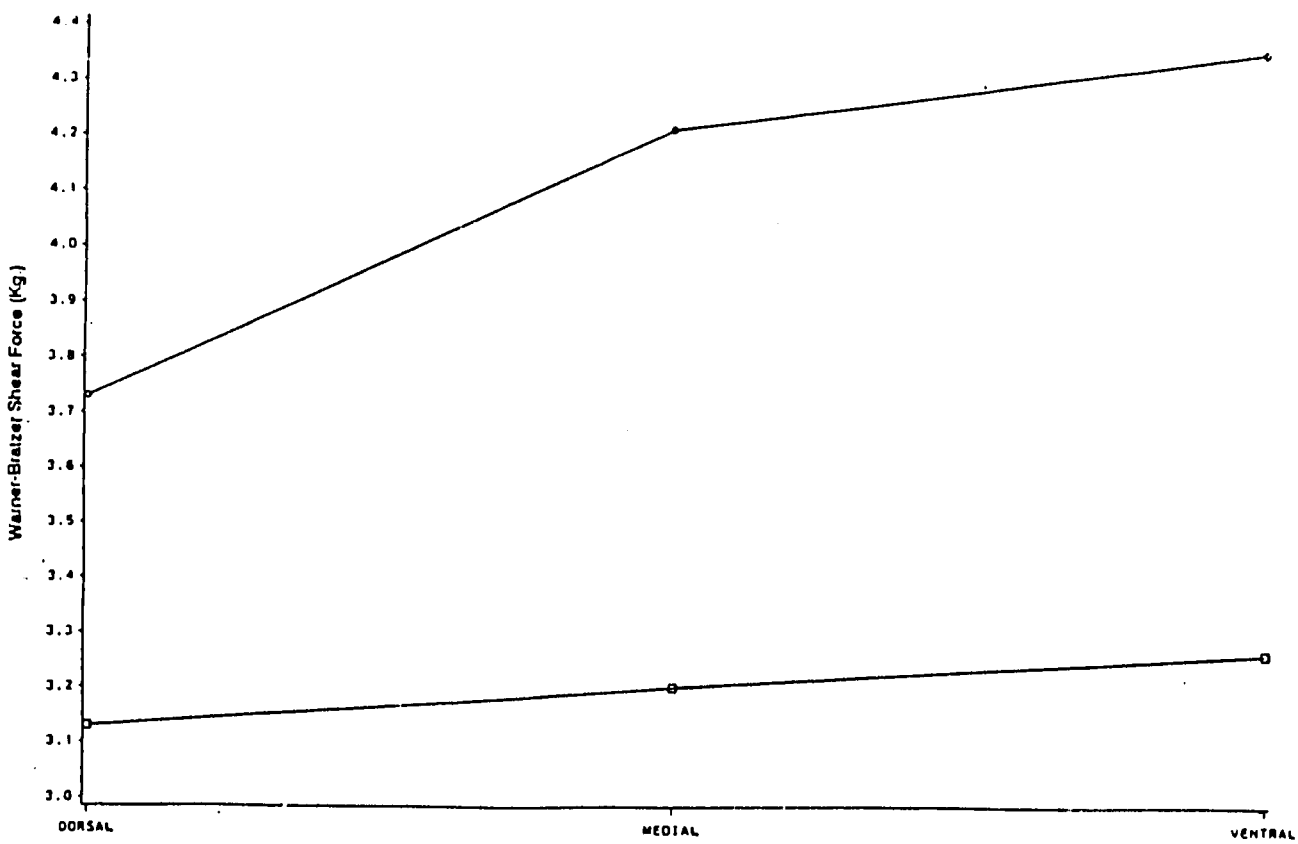
LEGEND DIAMOND --> BLACKBELLY LAMB SQUARE --> NEWZEALAND LAMB Day 1

FIGURE 5 BLACKBELLY LAMB - NEW ZEALAND LAMB SEMIMEMBRANOSUS MUSCLE



P<.01 LEGEND DIAMOND --> BLACKBELLY LAMB SQUARE --> NEWZEALAND LAMB Day 5

FIGURE 6 BLACKBELLY LAMB - NEW ZEALAND LAMB LONGISSIMUS MUSCLE



P<.01 Ventral
P<.01 Medial
NS Dorsal

LEGEND DIAMOND --> BLACKBELLY LAMB SQUARE --> NEWZEALAND LAMB Day 5

These results would indicate that the traditional processing of Blackbelly lamb at day 1 post-slaughter is not competitive in tenderness with the New Zealand lamb sold in Barbados supermarkets. Aging Blackbelly lamb for five days would provide a carcass with tenderness equal to or better than the imported New Zealand lamb.

There was no marked difference in dressing percentage, loineye, backfat, yield grade, or total score. Ram #2553 had the highest average of adjusted loineye measurements. Loineye in square inches was 2.18, 2.0 and 2.05, from #2553, #2912 and #2412, respectively. Lambs sired by #2912 had the highest values of H.P.K. (%) of 3.47 compared to #2553 of 3.12 and #2412 of 3.10. Leg confirmation score and quality grade was highest in carcasses sired by #2553. The leg confirmation average scores were 11.7, 11.4 and 10.8 from #2553, #2912 and #2412, respectively. Quality grade was 11.37, 11.0 and 10.6, respectively.

Variation in quality grade in the 36 carcasses ranged from an average good grade (8) to a prime minus grade (13). The quality grade scores of ram #2553 ranged from choice minus grade (10) to a prime minus grade (13). Ram #2912 quality grade scores ranged from 9 good plus (9) to prime minus (13) and #2412 quality grade ranged from average good (8) to choice plus (12), two quality grades lower than carcasses from #2553 and one grade lower than carcasses from #2912.

These results clearly point out that sire #2553 sired progeny superior in live weight, carcass weight, leg conformation score and loineye indicating more total red meat in the progeny carcasses. He was also superior in the breeding pens in fertility.

Increasing the characteristics of carcass quality and weaning weight from sire #2553 is becoming difficult due to the limitation of ewe numbers and space in the confinement system. There are 126 ewes in the original breeding program and 21 selected replacement ewe lambs. The problem confronting the selection and mating is inbreeding. Selection of superior animals in this small nucleus will require inbreeding eventually if the lambs that have high ratios continue

to come from this line. Coefficients of inbreeding of half sibs is 12.5% that is reduced by one-half in the next generation. Some linebreeding in this program may be beneficial. Linebreeding would allow more genes to be homozyzous or to increase the frequency of pairing of similar genes. The harmful effects of inbreeding that are most obviously reflected are poorer reproductive efficiency, including higher mortality rates, lower growth rates and a higher frequency of hereditary defects. Despite these generally harmful effects, it enables the researcher to uncover and eliminate harmful recessive genes within the population. It especially is essential in the development of prepotent ewes and more especially rams and is desirable in the development of distinct family lines. Prepotent animals breed "true" that is, they produce offspring that are genetically and phenotypically like themselves and they often breed better than they look. Progeny testing is a very useful method of identifying superior rams and the carcass data from these three rams clearly indicates the superiority of ram #2553.

Feed Evaluation and Analysis

The three formulated feeds were analyzed at the Livestock Nutrition Laboratory Services at the University of Missouri (table 13). The calcium to phosphorus levels in the ewe and lamb pellets formulated at 18% crude protein were low in calcium. The calcium levels in the 14% lamb feed were 2:1, calcium-phosphorus ratio. An analysis of native hay will be made, however, from observations, of the dry stemmy native hay, it appears to be very low in quality and nutrients.

Monensin was added to the feed to prevent coccidiosis, a common problem arising from coccidia infestation in the gut in lambs fed in drylot. At some time in the fall of 1986, the feed mill on the island discontinued adding Monensin to the feed and one group of lambs became heavily infested with coccidia, resulting in poor growth rate and three lamb losses. The problem was discovered when the veterinary service took fecal samples and analyzed them resulting in the diagnosis of coccidiosis. Due to the possible damage to the gut of these stunted lambs, they will not be retained for breeding.

TABLE 13
FEED ANALYSIS

SAMPLE ID		EWE PELLETS		LAMB-1 PELLETS		LAMB-2 PELLETS	
		As-Fed Basis	Dry-Matter Basis	As-Fed Basis	Dry-Matter Basis	As-Fed Basis	Dry-Matter Basis
Moisture.....	%	14.24	.00	14.10	.00	13.42	.00
Dry Matter....	%	85.75	100.00	85.69	100.00	86.57	100.00
Crude Protein.	%	16.48	19.22	17.46	20.33	13.39	15.47
ADJ Crude Prot	%	16.48	19.22	17.47	20.33	13.39	15.47
Avail Protein.	%	15.58	18.17	16.88	19.66	13.03	15.06
ADF Nitrogen..	%	.14	.16	.09	.10	.05	.06
A.D. Fiber....	%	7.22	8.42	5.12	5.97	4.71	5.44
N.D. Fiber....	%	21.76	25.37	18.98	22.09	13.98	16.15
TDN.....	%	73.11	85.26	75.74	88.18	76.89	88.81
N E Lact..MCAL/lb		.72	.84	.76	.88	.77	.89
N E Gain..MCAL/lb		.53	.62	.56	.66	.57	.66
N E Maint.MCAL/lb		.81	.94	.86	1.01	.88	1.02
Crude Fat.....	%	2.66	3.11	3.61	4.20	3.50	4.04
PH.....	%						
ASH.....	%						
Nitrogen.....	%	2.63	3.07	2.79	3.25	2.14	2.47
Calcium.....	%	.99	1.16	.59	.69	1.14	1.32
Phosphorus....	%	.77	.90	.70	.81	.56	.65
Magnesium.....	%	.34	.40	.27	.32	.21	.25
Potassium.....	%	1.00	1.17	.96	1.11	.59	.68
Sodium.....	%	.19	.23	.18	.21	.18	.21
Sulphur.....	%	.18	.21	.19	.22	.16	.19
Iron.....	PPM	199.48	232.61	198.87	231.51	197.66	228.32
Copper.....	PPM	3.95	4.60	7.91	9.21	5.93	6.85
Manganese.....	PPM	118.50	138.18	107.84	125.55	94.88	109.59
Zinc.....	PPM	77.02	89.82	76.18	88.69	73.13	84.47

Ultrasound Evaluation

The ultrasound (scanoprobe) measurements of loineye and backfat were included in the selection of ram and ewe lamb replacements to be bred to produce the second generation. Following selection based on 120-day weaning weight ratios over 100, visual appraisal for culling lambs down on their feet, off-in-the-mouth (brachygnathia) and other physical defects, the

scanoprobe measurements of loineye and backfat were evaluated. Loineye measurements of ewe lambs with less than 1.25 sq. in. were not selected from the ewe lambswith ratios over 100 in weaning weight (table 9).

Ram lambs selected for potential breeders in generation 2 were scanoprobed for loineye and backfat. They were then selected using 120-day weaning weight ratio, visual appraisal evaluation, and fertility examination. Muscle thickness was determined by visual appraisal and all remaining ram lambs were scanoprobed and each measured 2.64 sq. in. with one exception, the ram sired by #2553, and #2412 measuring 2.97 sq. in. (table 7).

SUMMARY AND CONCLUSIONS

The project team of researcher and support staff in Barbados have provided competent leadership and very complete and accurate data collection. The project staff are well qualified, motivated and understand the goals and objectives of the project. Day to day problems are identified and solved by the Barbadian researchers and support staff.

Due to the variation in weaning weight, height, length and carcass quality and quantity of the Blackbelly sheep, continuation in selection for prolificacy, weaning weight and carcass quality and cutability will be necessary to achieve the goals originally determined for the Blackbelly by the Ministry of Agriculture in Barbados. Recognition of the breed for very flavorful meat, prolificacy and adaptability is well-known to the scientist in Barbados.

The potential for profit for sheep farmers on the island raising Blackbelly sheep is great. They are an ideal sheep to export anywhere in the world where prolificacy is low. In a crossbreeding program, the Blackbelly should contribute as much or more than the Finnsheep, Romanov or Booroolo Merino.

The meat of the Blackbelly is unique in flavor. The tenderness of the meat for the hotel trade on the island was quite satisfactory when the meat was aged to day 5. Warner-Bratzler-shear

test measuring tenderness showed the semi-membranosus muscle and longissimus muscle acceptable in tenderness. Processing Barbados Blackbelly lamb on day 1 post-slaughter as is traditionally practiced results in meat that is less tender than the lamb processed on day 5 ($P<.01$). Aging for 5 days at 40C resulted in a more tender semi-membranosus muscle in the Blackbelly compared to the New Zealand lamb purchased frozen at the supermarket (9.48 lbs. vs. 13.3 lbs.). The longissimus muscle comparison resulted in a 8.88 lbs. vs. 7.05 lbs. for the Blackbelly and New Zealand lamb, respectively ($P<.01$). (Figure 1-6). Sensory panel results agreed with the Warner-Bratzler shear results (Figure 7-12). Aging Blackbelly lamb to day 5 improved flavor, juiciness and tenderness of the longissimus and semi-membranosus muscle rather than processing the lamb at day 1 post-slaughter, the traditional method.

Recommendations

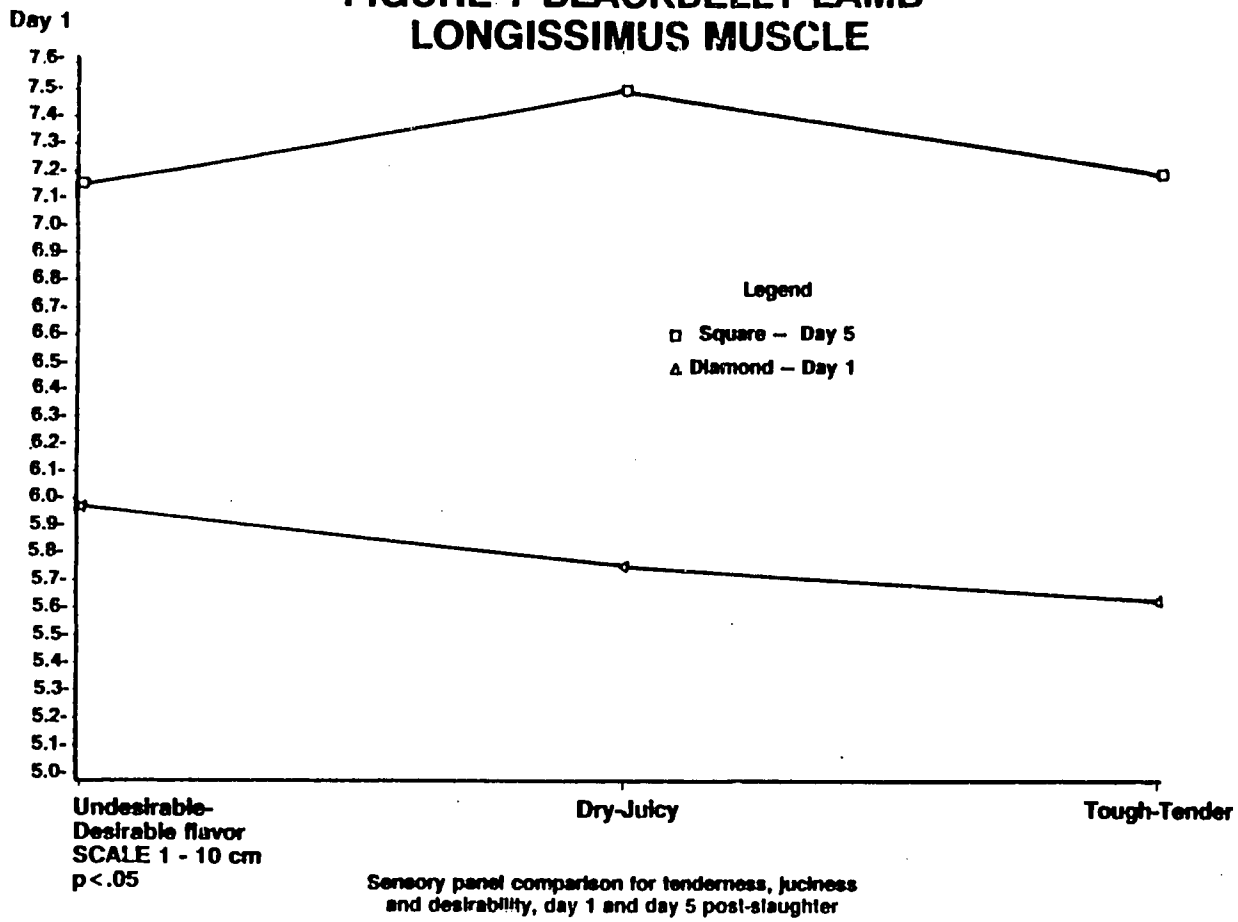
Serial slaughtering lambs from 5 to 8 months of age would help identify the ideal age for slaughtering the lambs. The tourist trade on the island is increasing and tourists often look for restaurants that serve exotic native food.

The Blackbelly meat is more beef-like in texture and color than traditional lamb. The aroma when cooking the meat is different than either lamb or beef which may contribute to the uniqueness of the flavor of the meat.

Raising Blackbelly sheep in confinement requires increased variable feed costs. Developing the lamb as a unique island meat supplied by Blackbelly farmers for the hotel trade would benefit both the farmers and the hotel trade. Flying fish and other fish are special entrees in the hotel trade. Blackbelly lamb could be added to menu and develop a reputation that would result in increased income for Barbados.

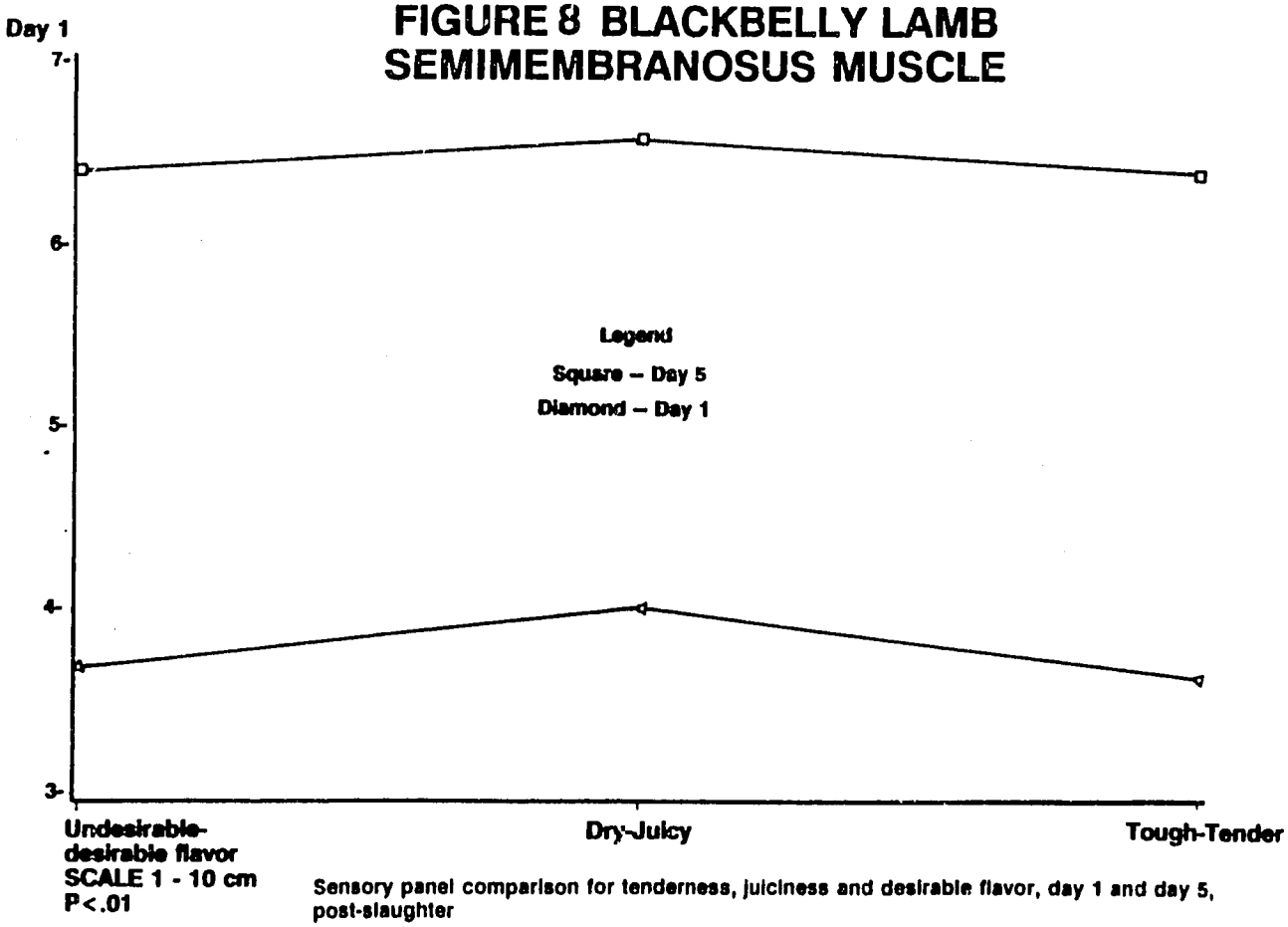
Carcass data collection will need to be continued with each generation. As sires are selected from the next generations, progeny testing offspring selected at random, measuring

FIGURE 7 BLACKBELLY LAMB LONGISSIMUS MUSCLE



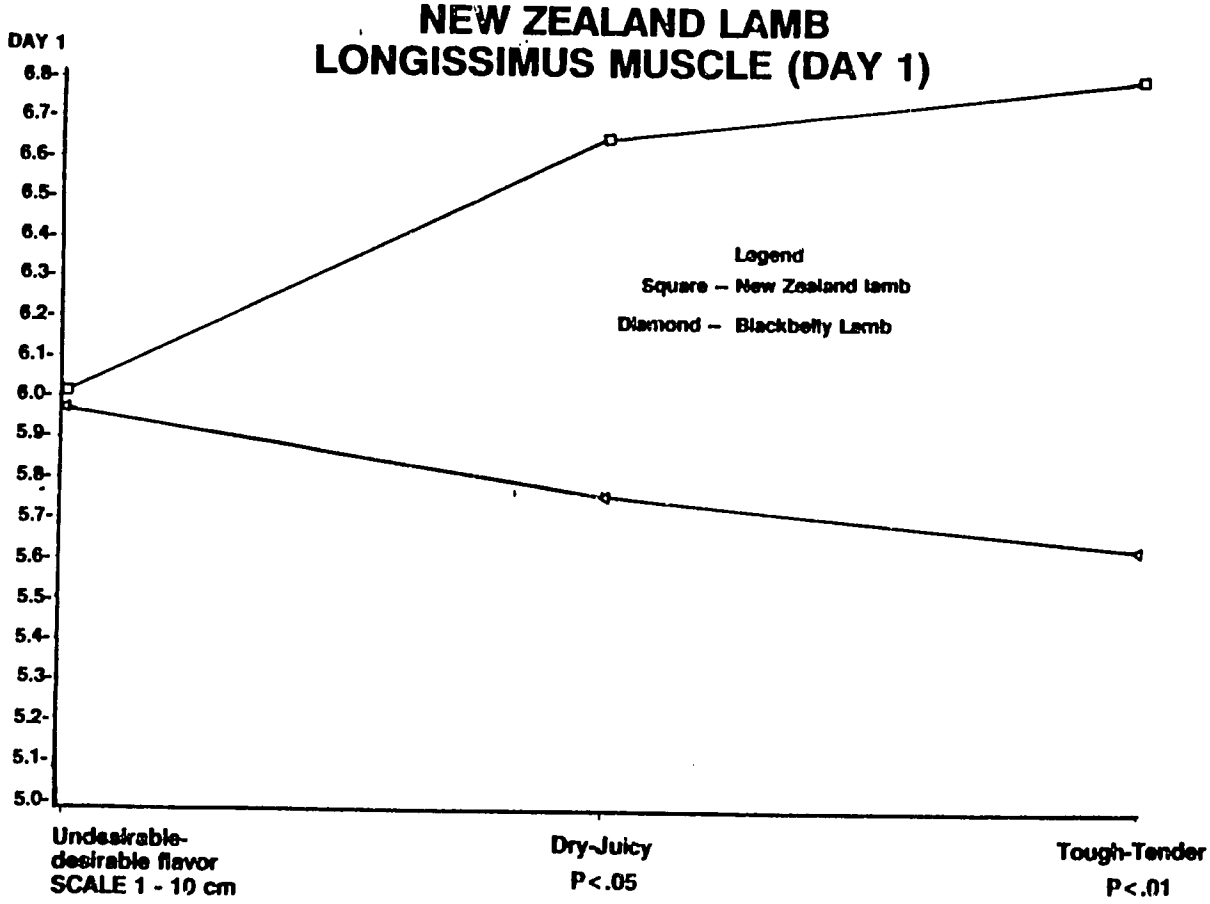
Sensory panel comparison for tenderness, juiciness and desirability, day 1 and day 5 post-slaughter

FIGURE 8 BLACKBELLY LAMB SEMIMEMBRANOSUS MUSCLE



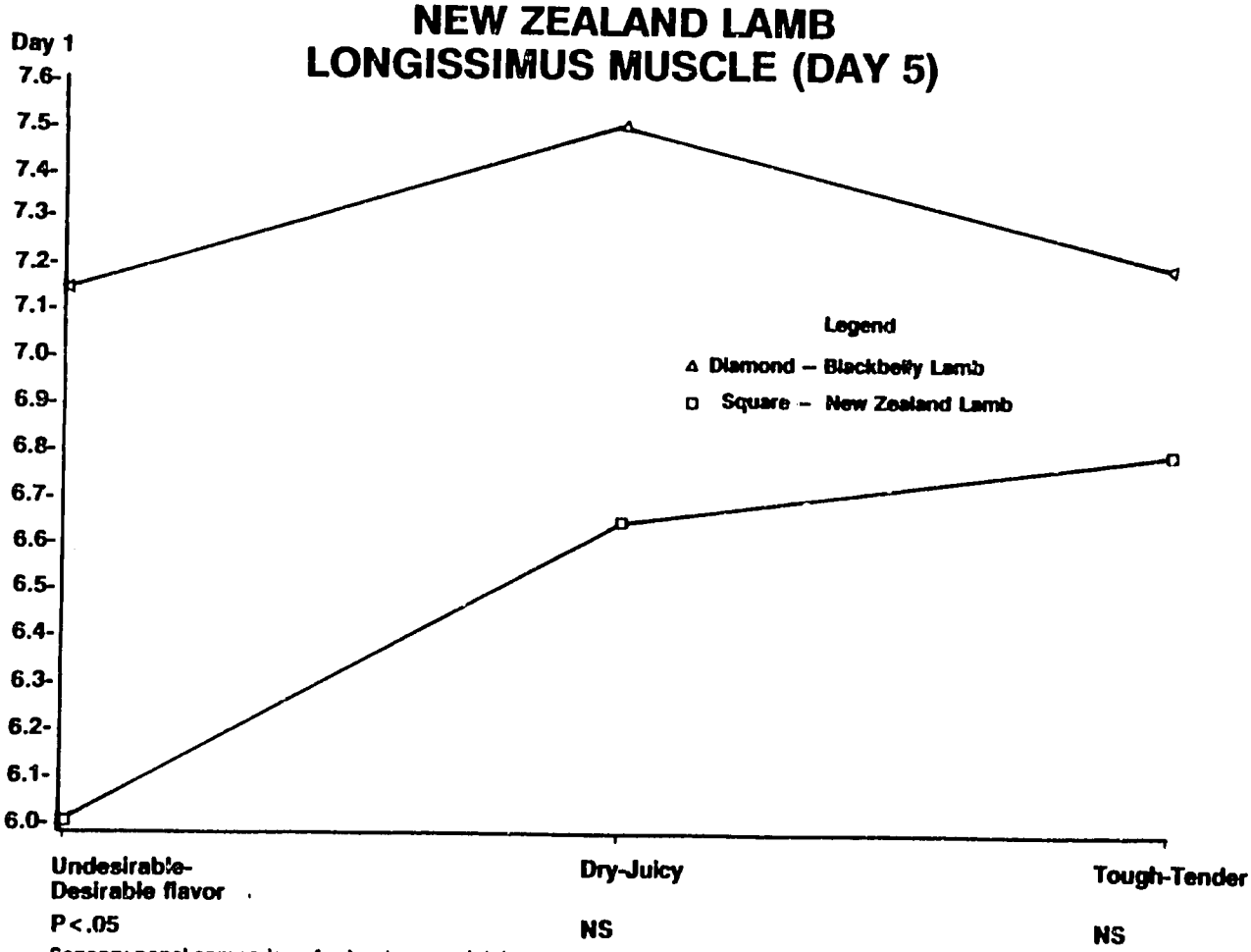
Sensory panel comparison for tenderness, juiciness and desirable flavor, day 1 and day 5, post-slaughter

FIGURE 9 BLACKBELLY LAMB NEW ZEALAND LAMB LONGISSIMUS MUSCLE (DAY 1)



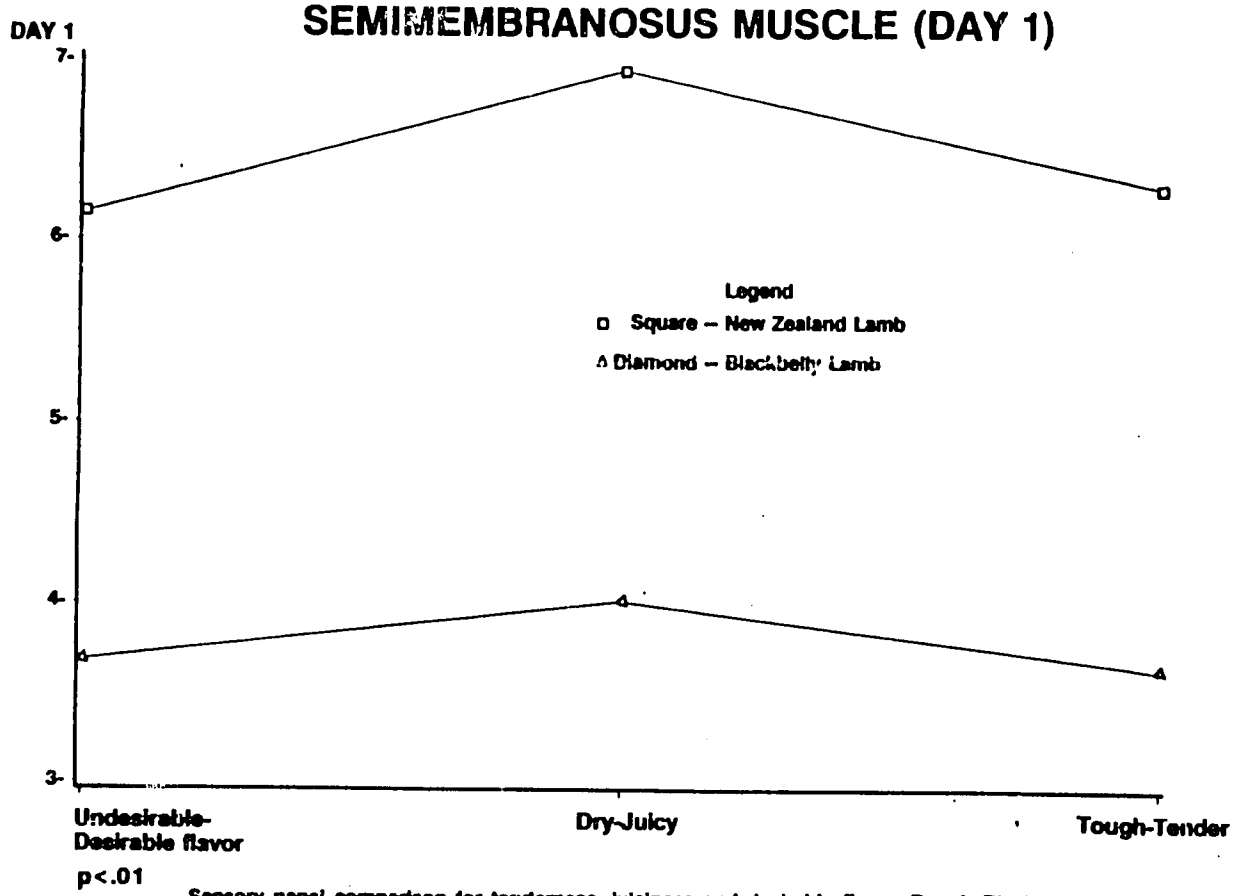
Sensory panel comparison for tenderness, juiciness and desirable flavor, day 1 and New Zealand lamb

FIGURE10BLACKBELLY LAMB NEW ZEALAND LAMB LONGISSIMUS MUSCLE (DAY 5)



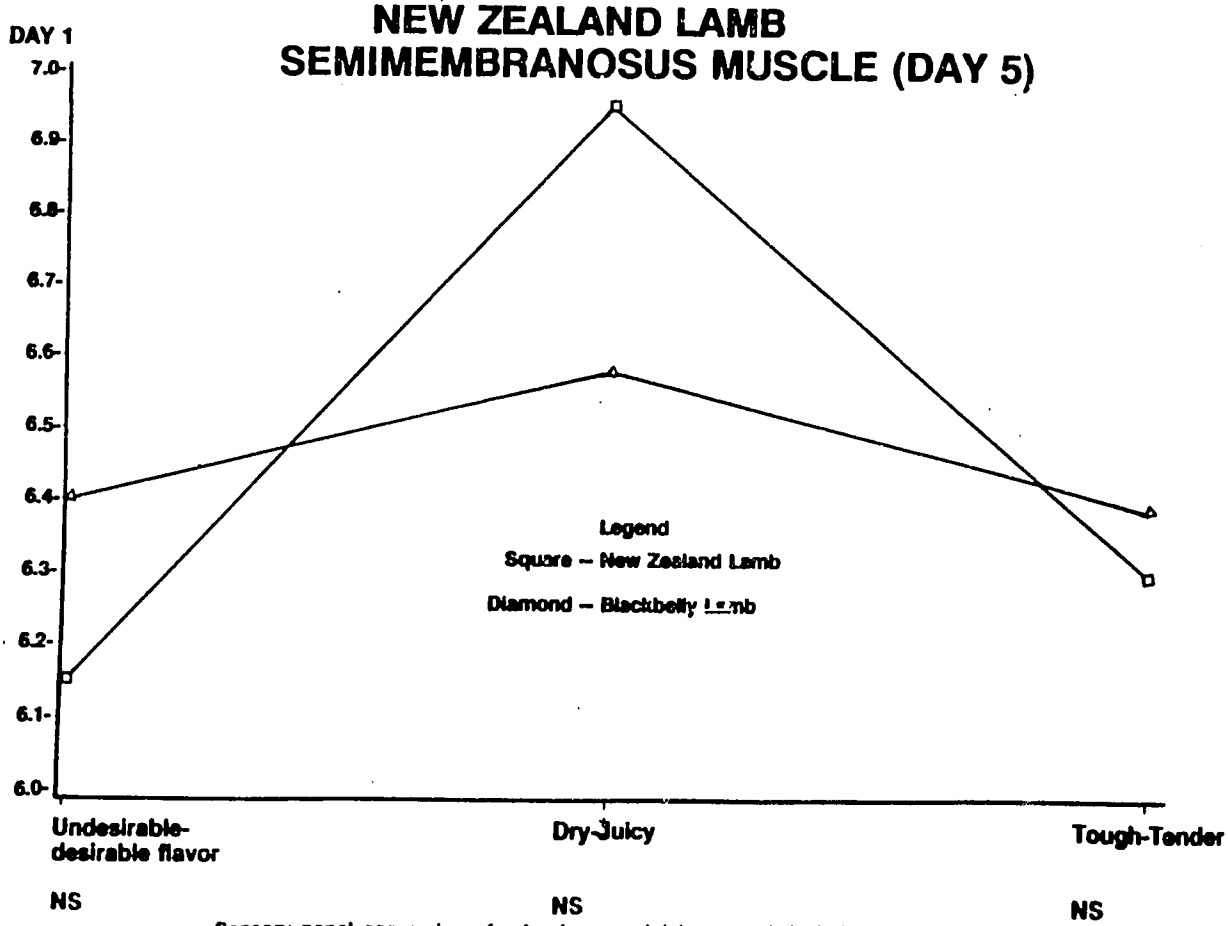
Sensory panel comparison for tenderness, juiciness and desirable flavor, Day 1, Blackbelly lamb an New Zealand lamb

FIGURE11BLACKBELLY LAMB NEW ZEALAND LAMB SEMIMEMBRANOSUS MUSCLE (DAY 1)



Sensory panel comparison for tenderness, juiciness and desirable flavor, Day 1, Blackbelly lam and New Zealand lamb

FIGURE 12 BLACKBELLY LAMB NEW ZEALAND LAMB SEMIMEMBRANOSUS MUSCLE (DAY 5)



Sensory panel comparison for tenderness, juiciness and desirable flavor, Day 5 Blackbelly lamb and New Zealand lamb

carcass characteristics will provide needed information of the superior sires in each generation. A selection index should be formulated for weaning weight, height, length and carcass quality and quantity. Carcass information on live animals can be identified with a sonoscope measuring loineye and backfat.

A systems approach for comparing confinement raised Blackbelly sheep with pasture raised sheep would help identify which system or combination of systems would be most economical.

Marketing agriculture products has been a problem and continues to be on the island. No grading system for lamb exists. Present marketing strategy of Blackbelly lamb would prohibit the time and effort spent in lamb grading. New Zealand lamb is in competition with Blackbelly lamb and is subsidized by the New Zealand government making it difficult to compete in price. Meat handlers need training in meat cutting for the hotel trade. A total program of merchandising such as the American Sheep Producers Council conducts would be helpful once the research on age to slaughter lamb and tenderness at various ages is identified.

The project team could more effectively interface with existing extension service, private firms, farm groups and others to make available the information being generated by the project.

The capacity of the extension service to transfer technology and good linkage with the research project is minimal and limits the potential impact of the project. Effectiveness of the extension service is difficult to overcome because of limitation of staff training and resources. The marketing component of the project should be more closely linked with the research planning process.

A 4-H program with extension supervision would provide an educational program for youth to learn all aspects of raising Blackbelly sheep. A Blackbelly youth show for 4-H members that would provide an activity that would bring the sheep together in a centralized location to compare rate of gain, lambing rate and conformation would greatly expand knowledge of Blackbelly sheep and provide visibility to the breed on the island.

Sire evaluations have been conducted and sire summaries should be made available to sheep farmers or the island.

REFERENCES

Patterson, Harold C., 1984. Performance of Barbados Blackbelly sheep in two experimental flocks in Barbados. A status report. Fifth Regional Livestock Meeting. Nassau, Bahamas.

Blaylock, L.G., 1984. Commercial and small farm management and feeding of Blackbelly Sheep in Barbados. Ministry of Agriculture Food and Consumer Affairs, Barbados.

Romans, J.R., 1979. Final Report - Carcass evaluation and composition of a sample of Barbados Blackbelly Sheep. Caribbean Council.

WORKSHOPS

Workshops have been held for Barbadian scientists and support staff on the following:

1. Genetic theory and selection - March, 1986.
2. Operation of the microcomputer to expedite record calculations for use in selection and culling of replacement ewe and ram lambs in the project - March, 1986.
3. Meat grading of slaughter lambs in quality grade and yield grade (cutability) - May, 1986 and August, 1986.
4. Scanoscope determinations for live animal evaluation for total red meat - August, 1986.
5. Visual appraisal evaluation and limitations in selection - March, 1986.
6. Scrotal circumference measurements and the application for predicting reproductive performance in rams - August, 1986.

BARBADIAN SCIENTISTS VISIT MISSOURI

Michael Hunte, Senior Livestock Officer in Barbados and John Vaughan, Project Manager in charge of the Blackbelly sheep project, visited Missouri in early September. Several sheep, swine, and cattle operations were visited. Different breeds of sheep were observed at the World Sheep Festival in Bethel and the Barbadian scientists were keenly interested in the auction sales

conducted in Bethel. This type of marketing is in its infancy for selling livestock in Barbados and they felt expansion of this would benefit livestock producers.

The Urban Gardening project in St. Louis was visited and some aspects of the program were viewed as helpful in helping to grow vegetables on the island of Barbados for home consumption.

The Small Farm Family Program in Missouri, which has been in existence since 1971, has similarities to the Rural Development Project on Barbados. This Small Farm Family Program has some components that might be adapted, such as educational assistants contacting small farmers to extend educational information, one-on-one.

A field day in the Bootheel of Missouri was attended at Portageville and the scientists had the opportunity to meet extension field staff and administrators from UMC and Lincoln University. Cotton is a commodity being introduced in Barbados as a replacement for the greatly depressed sugarcane industry and information was obtained on varieties and technology of harvesting cotton.