GROWTH PERFORMANCE AND MEAT CHARACTERISTICS OF THE FIRST AWASSI BACKCROSS THAT HOLDS THE CALLIPYGE GENE

By

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Outline

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Introduction

- **Awassi is a multi-purpose breed raised for meat, milk, and wool production.**
- **Its well known for its high adaptation to harsh, semiarid environments and its resistance to diseases.**
- **Awassi is the dominant sheep breed in many Middle Eastern countries and it is the only local breed of sheep in Jordan.**
- **The Awassi sheep breed suffer from inferior carcass merit and poor leg muscling and high fat percentage compared to other meat breeds.**

Introduction

- **Progress in improving productive and reproductive traits, especially in growth and meat production characteristics, are the major aims for sheep breeders.**

- **Improving productive and reproductive traits of sheep can be done using several approaches.**

- ✓ **Within breed selection**

- ✓ **Crossbreeding Awassi (with selection) with exotic mutton breeds may improve carcass composition but may have undesired effects on adaptability.**

- ✓ **Or by the introgression of some favorable genes such as the Callipyge gene:**

Callipyge gene

- **The CLPG gene is a mutation in sheep responsible for muscle hypertrophy.**
- **The hypertrophy results from an increase in the size of the muscle fibers and is most prominent in the loin and hindquarters of the affected animal (fig.1).**
- **Phenotypic expression of the Callipyge gene cannot be seen until 4 to 6 weeks of age and therefore it does not has the parturition drawbacks of other muscling mutations (double muscle gene in cattle).**

Muscle hypertrophy

Callipyge gene

- **The CLPG locus has been mapped to the telomeric region of sheep chromosome 18 .**

- **The inheritance of the CLPG phenotype has a non-Mendelian pattern termed polar overdominance.**

- **Characteristics**
  - **CLPG lambs convert feed more efficiently , have higher dressing percentages and have up to 42% more muscle mass compared with normal phenotype lambs.**

  - **The disadvantage of the CLPG phenotype is the increased toughness of the Longissimus muscle.**

Objective of the research

- **To produce the first Callipyge –Awassi back cross.**
- **To evaluate the effect of the callipyge gene on growth performance, carcass characteristics and meat quality of Awassi sheep.**

Materials and Methods

❖ ***Animals and breeding strategy***

- **This experiment was conducted in Agricultural Center for Research and Production at Jordan University of Science and Technology, Irbid (JUST Irbid).**

- **Impregnated sponges with progesterone hormone were used for synchronizing the estrus during hand mating and or/ artificial insemination for achieving high fertility rate.**

- **A total number of 60 pure awassi ewes were mated with three F1 rams (50% Rambouillet, 50% Awassi) that were heterozygous for the callipyge gene to produce the first backcross Callipyge-Awassi(FBC) (25% Rambouillet, 75% Awassi rams)**

F1 Ram (50% Rambouillet, 50% Awassi) X Pure Awassi ewe

FBC (25% Rambouillet, 75% Awassi rams)

The improved new line of awassi will look phenotypically like the pure Awassi but holding the callipyge gene (that is preferred by the farmers and of high prices compared to the imported or exotic breeds).

Pure Awassi

FBC

F1

❖ *Lambing and growth rate measurement*

- **After lambing , new born lambs were identified by permanent ear tags, and all informations were recorded for the new-born (sex, type of birth, dam number, sire number and birth weight).**

- **Then the regular lactation period started and continued for full day suckling up to 15 days, where creep feeding started, and continues up to the full weaning that occurs at approximately 70 days.**

- **The lamb that was at least (14 kg) weaned immediately and the weaning weight was recorded immediately.**

❖ *Fattening trial*

- **The fatting trial was conducted using individual pens .**
- **Two genotype groups were included in trial :**
  1. **Callipyge carrier ram lambs (n= 8)**
  2. **Pure Awassi ram lambs (n= 8)**
- **All lambs were weighted weekly and feed intake was measured in daily bases.**
- **A standard ration was offered to all lambs during the trial (Table 1) .**

Table 1: Ingredients and chemical composition of the diet fed to two genotypes.

Diets	Item
Ingredients (% DM)	
Barley	61.4
Soybean meal	15
Wheat straw	21
Salts	1.5
Limestone	1
Minerals and vitamins	0.1
Nutrients	
Dry matter (%)	91.1
Organic matter (%)	86
Crude protein (%)	16.8
Neutral detergent fiber (%)	22.6
Acid detergent fiber (%)	11.7
Ether extract (%)	3
ME (Mcal/Kg)*	2.7

*ME: Metabolizable energy; calculated using NRC (1985)

❖ *Slaughter procedures*

- **Final and fasted live weights were recorded before slaughtering.**
- **Hot carcass weight and weights of non-carcass components were weighted and recorded immediately after their removal from the abdomen.**

•Mesenteric fat	•Testes
•Trachea and lungs	•Kidneys
•Heart	•Kidney fat
•Liver	•Spleen

- **After chilling the carcasses for 24 h at 4°C, cold carcass weights were recorded.**

❖ ***Cuttings***

- ➢Shoulders
- ➢Racks
- ➢Loins
- ➢Legs
- ➢Fat tail

❖ ***Linear Dimensions and fat depth measurements***

- ➢Rib-eye area
- ➢Fat depths
- ➢Tissue depth (GR)
- ➢Rib fat depth (J)
- ➢Eye muscle width (A)
- ➢Eye muscle depth (B)
- ➢Eye muscle area,
- ➢Fat depth (C)
- ➢Shoulder fat depth (S2)
- ➢Leg fat depth (L3)

❖ ***Dissection procedure***

- ➢ **The right leg cut was dissected to determine their total muscle, total bone, Intramuscular fat, and subcutaneous fat .**

❖ *Meat Quality Measurements*

- **Measurements of meat quality characteristics made on the loin muscle (M. Longissimus).**
- **Shear force values, cooking loss, water holding capacity (WHC), PH and color coordinates (L*, a*, and b*) were measured.**

❖ *Statistical Analysis*

- **Data were analyzed by the mixed procedure of SAS.**
- **The initial weight was included as covariate for the following traits: final body weight, fasting live weight, hot carcass weight, cold carcass weight, dressing percentage and average daily gain.**
- **Significant differences were considered at $P \leq 0.05$.**

RESULTS

Growth performance

Table 1: Least square means ± S.E for the effect of genotype on growth performance of pure Awassi (AW) and the first backcross Callipyge Awassi (FBC)

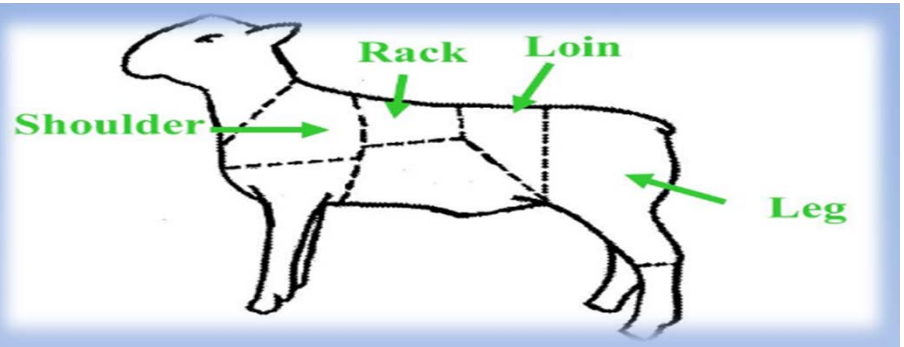
Trait	Genotype		P-value	Covariate
	Pure Awassi	Callipyge Awassi		
Initial body weight (kg)	19.3500±1.3419	22.8438±1.3419	0.0885	
Final body weight (kg)	36.9867±1.5421	48.9508±1.5421	0.0002	0.0063
Average Daily gain (Kg)	0.1892±0.01836	0.3316±0.01836	0.0002	0.8884
Dry matter intake (Kg)	77.0540±4.6595	104.73±4.6595	0.0010	
Feed conversion Ratio (kg/kg live weight)	5.0202±0.2643	3.8027±0.2643	0.0062	

Carcass components

Table 2: Least square means ± S.E for the effect of genotype on Carcass components of pure Awassi (AW) and the first backcross Callipyge Awassi (FBC).

Trait	Genotype		P-Value	Covariate
	Pure Awassi	Callipyge Awassi		
Final body weight (Kg)	37.0755±1.6612	50.9245±1.6612	0.0001	0.0072
Average Daily gain (Kg)	0.1630±0.01695	0.3044±0.01695	0.0001	0.9769
Fasting live weight (Kg)	35.7120±1.5529	48.7255±1.5529	0.0001	0.0142
Hot carcass weight (Kg)	18.0135±0.9442	26.4240±0.9442	<.0001	0.0021
Cold carcass weight (Kg)	17.4959±0.9118	25.6666±0.9118	<.0001	0.0022
Dressing %	51.4602±1.3080	55.1507±0.9629	0.0087	0.0050

Carcass components



Trait	Genotype		P-value
	Pure Awassi	Callipyge Awassi	
Shoulders weight(Kg)	7.3506 ± 0.8398	10.4927 ± 0.5300	0.0002
Legs weight(Kg)	6.3872 ± 0.9030	10.1564 ± 0.6042	0.0002
Racks weight(Kg)	1.3823 ± 0.1472	2.5528 ± 0.1472	< .0001
Loins weight(Kg)	1.6242 ± 0.2507	2.8708 ± 0.1616	< .0001
Fat tail weight(Kg)	1.6350 ± 0.3729	1.2528 ± 0.2751	0.2981

Pure Awassi

Callipyge Awassi

Pure Awassi

Callipyge Awassi

Component of dissected leg and loin cuts

Table 3: Least square means± S.E for the effect of genotype on dissected leg and loin cuts pure Awassi (AW) and the first backcross Callipyge Awassi (FBC).

Trait	Genotype		P-Value
	Pure Awassi	Callipyge Awassi	
Longissimus weight (Kg)	0.1930±0.04666	0.3614±0.02964	0.0003
Leg weight (Kg)	3.0471 ± 0.4616	5.0371±0.3174	0.0002
Total Leg Muscle weight (Kg)	1.7866 ± 0.3135	3.0026 ± 0.2032	0.0002
Intermuscular Fat (Kg)	0.07875 ± 0.01629	0.1403 ± 0.01629	0.0193
Subcutaneous Fat (Kg)	0.3489 ± 0.07075	0.6880 ± 0.07075	0.0048
Total Bone (Kg)	0.6641 ± 0.04183	0.8611 ± 0.04183	0.0054
Meat to fat ratio	3.4306±0.3218	3.6545±0.3218	0.6309

Non-carcass components

Table 4: Least square means ± S.E for the effect of genotype on non-carcass components weight of pure Awassi (AW) and the first backcross Callipyge Awassi (FBC).

Trait	Genotype		P-Value
	Pure Awassi	Callipyge Awassi	
Mesenteric Fat weight(Kg)	0.4585 ± 0.09060	0.4688±0.05632	0.8757
Lungs & trachea weight(Kg)	0.5193 ± 0.04100	0.5793 ± 0.03561	0.2391
Heart weight(Kg)	0.2127 ± 0.03635	0.2735 ± 0.02426	0.0591
Liver weight(Kg)	0.5500 ± 0.04555	0.7205±0.04555	0.0201
Spleen weight(Kg)	0.06025 ±0.008735	0.08050 ± 0.008735	0.1251
Kidney weight(Kg)	0.08966±0.006938	0.1267±0.006100	0.0007
Kidney Fat weight(Kg)	0.1016 ± 0.05105	0.2555 ± 0.03875	0.0091
Testes weight(Kg)	0.1560 ± 0.02962	0.2698 ± 0.01902	0.0002

M. Longissimus Linear Dimensions and Fat measurements

Table 5: Least square means for the effect of genotype on M. longissimus linear dimensions and fat measurements of pure Awassi (AW) and the first backcross Callipyge Awassi (FBC).

Trait	Genotype		P-Value
	Pure Awassi	Callipyge Awassi	
Fat thickness (L3) (mm)	6.4375±0.8023	10.3750±0.8023	0.0041
Tissue depth (GR) (mm)	13.6875±1.2063	20.2500±1.2063	0.0020
Rib fat depth (J) (mm)	6.3668±1.0248	8.5633±0.8544	0.0785
M. longissimus width (A) (mm)	59.8750±1.5587	73.4375±1.5587	< .0001
M. longissimus depth (B) (mm)	25.1103±1.4732	39.2124±1.4315	< . 0001
Eye muscle area (cm^2)	14.8099±2.0666	25.3521±1.4086	< .0001
Fat depth (C) (mm)	2.1250±0.6917	4.9375±0.6917	0.0130
Fat thickness (S2) (mm)	4.0205±0.8798	6.5158±0.7033	0.0191

M. longissimus

Callipyge Awassi

Pure Awassi

Meat quality

Table 6: Least squares mean ± S.E for the effect of genotype on Meat quality characteristics of pure Awassi (AW) and the first backcross Callipyge Awassi (FBC).

Trait	Genotype		P-Value
	Pure Awassi	Callipyge Awassi	
Shear Force (kg/cm^2)	3.2187 ± 0.5655	7.2844 ± 0.5655	0.0002
Cooking Loss (%)	43.1336 ± 0.4592	41.2642 ± 41.2642	0.0129
Water Holding Capacity (%)	19.0389 ± 3.2093	26.3282 ± 2.0048	0.0077
PH	5.8013 ± 0.02664	5.8737 ± 0.02664	0.0765
Color evaluation			
Lightness (L)	35.3467 ±85.0007	35.5454±85.0007	0.8712
Redness (a)	3.1467 ± 18.7540	2.9925 ± 18.7540	0.5710
Yellowness (b)	17.2294 ± 86.5394	17.8049 ± 54.4810	0.3798

Conclusion and Recommendations

- **Growth performance and quality of the Awassi sheep have been improved through the introgression of the callipyge gene into the Awassi sheep.**

- **CLPG gene can be used in structured mating systems to make dramatic improvements in growth rate, feed efficiency, and average daily gain, dressing percentage and carcass composition of Awassi sheep.**

THANK YOU