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SOME PRODUCTIVE TRAITS OF CYPRIOT GOATS AND ITS EFFECT ON GENETIC MANIFESTATIONS OF THE FADS1 GENE

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Abstract:

This study was conducted with the aim of identifying some genetic features of the FADS1 gene and its relationship to some productive traits of local goats, studying the components of milk from protein, fat, lactose and non-protein mineral elements, estimating the live weight of mothers, birth weight, weaning weight, length of milk season and gene-duplication, the effect of live weight was significant (P<0.05) in all genetic manifestations as well as the length of the milk season is significant (P<0.05) in most genetic manifestations and the percentage of fat in the components of milk was also significant (P<0.05), while other productive traits and milk components did not have a significant effect.

Keywords:

INTRODUCTION

Goats are one of the species of the genus ibex and are strong animals that can withstand living in different environments, they live high in the mountains and in the plains and even in oases and deserts. The goat's body is graceful, strong and covered with hair, which enabled them to easily find their food on the ground and even climb bushes to eat leaves and buds. The Cypriot goat, also known as Shami goat or Damascene goat, is a breed of goat that is bred because of its ability to produce milk, and is found mainly in Cyprus, Lebanon and Syria, goat milk is characterized by being a food source for poor and malnourished communities living in developing regions in addition to meeting the needs of people with milk allergy (Pearson,1976), goat milk has a normal fat content due to the large numbers of fatty acids found in it (Pajor et al.,2013), and is considered easy to digest than cow's milk due to the size of small fatty granules (Schuck et al.,2010).

Shami Goat:

This breed originated in the Levant and is believed to be Indian origin and is considered one of the goats dedicated to the production of milk of the characteristics of the Shami goat that it is characterized by large size and often be red or brown in color as there are other colors such as gray. Shami or Cypriot goats are characterized by long hair and may be horned or without horns, the weight of Cypriot goats or Shami goats for the male is about 70 to 90 kilos in puberty and full fattening. The weight of a female Cypriot goat or Shami goat may range from 50 kg to 60 kg per puberty.

Characteristics Of Shami Goats Or Cypriot Goats

1- Shami goats or Cypriot goats have many striking characteristics, they are characterized by nobility and beauty.
2- They are used in the production of various other breeds, including some of the specifications of the purebred Shami goats.
3- Shami goats or Cypriot goats are characterized by large production of milk and also high efficiency in meat production.
4- A female Shami goat or Damascene goat can produce up to 1.5 kilograms of milk per day.
5- Shami goat milk is easy to digest and very good for anyone suffering from digestive problems.
6- Shami goats or Cypriot goats are also characterized by calm and good behavior during breeding periods.

MATERIALS AND METHODS OF WORK

This study was conducted at the Ruminant Research Station of the General Organization for Agricultural Research / Ministry of Agriculture in Abu Ghraib on a sample of 30 Cypriot goats, while laboratory analyzes were carried out in the laboratories of the Scientific Progress Company specialized in molecular genetics and biotechnology, with the aim of separating the genetic material and determining the genetic structures (Genotype) of the FADS1 gene and its relationship to the productive and reproductive performance and growth characteristics of Cypriot goats.

Herd Management

The animals are raised in semi-open pens (40% roofed and 60% open) designated for their shelter, the

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herd is managed according to a program that includes nutrition, preparation for the mating season, preparation for pregnancy and childbirth, as well as health and veterinary care.

Nutrition

The feeding of animals at the station depends on grazing as they are taken out for grazing in the winter from 8 am to 2 pm, in the summer, they are taken out for grazing from 8 am to 12 pm and from three o'clock in the afternoon to six o'clock in the evening, upon her return to the station, her food needs are supplemented by providing jet, barley and alfalfa mixtures, the method of food payment was used a month before the start of mating, where animals are given 750 grams of concentrated feed per head per day, "and the amount is adjusted after feeding to 500 grams per head per day."

Field measurements

Blood samples

3 ml of blood was collected from the jugular vein area of each animal in a collection tube containing an EDTA K3 anticoagulant and the animal's number was recorded in each tube of its own and transported in a dedicated refrigerant storage box to the laboratory and kept in the refrigerator at a temperature of 4°C and the start of DNA extraction the next day.

Measuring Milk Production:

Milk production was recorded once a month until the end of the production season, and the amount of milk in the field was measured using a graduated cylinder, as the newborns were isolated from their mothers in the evening and milked the next morning early, and then the newborns were released to the mothers, and milk samples were taken from each animal and milk samples were placed for each animal in special tubes and transported with a refrigerated storage box to the laboratory, the proportions of milk components were measured (total fatty acids, non-fatty solids, fat percentage, protein, lactose) were measured, the length of the milk season was calculated, the peak production was calculated, and the total milk production was calculated from the following equation:

Total milk production = daily milk production rate × number of milking days

Gene FADS

It is a rate-limiting enzyme in the synthesis of polyunsaturated fatty acids (PUFAs (Guillou et al. 2010). The protein encoded by the FADS1 gene is a member of the FADS family of fatty acid genes in humans located on chromosome 11 and in mice located on chromosome 19.

$Y_{ijklm} = \mu + FADS1_i + A_j + S_k + O_l + e_{ijklm}$

Whereas:

It desaturates omega-3 and omega-6 polyunsaturated fatty acids in delta-5 mode, in the formation of eicosapentaenoic acid (EPA) and arachidonic acid. (Brenna,2009), desaturase enzymes (such as those encoded by FADS1) regulate fatty acid unsaturation by inserting double bonds between the specific carbon of the fatty chain of acyl, members of the FADS family are considered fusion products consisting of a cytochrome B5 N-like peripheral and C-end Extended membrane polyunsaturation part The formation of long-chain polyunsaturated fatty acids (LC-PUFAs) in tissues is essential for maintaining metabolic function and health, several complex diseases such as psychiatric disorders, metabolic syndrome, cardiovascular disease, and allergies have been associated with LC-PUFA levels, analysis of factors determining the formation of fatty acids in human tissues will help to understand and prevent the development of complex diseases associated with fatty acids, in addition to diet, an important factor for determining LC-PUFA levels in human tissues is the desaturation pathway of fatty acids, in this path, LC-PUFAs are manufactured internally from precursor essential fatty acids (linoleic acid and alpha-linolenic acid) by successive desaturation and chain elongation, the rate-determining enzymes in this reaction chain are delta-5), delta-6 desaturases D5D and D6D) encoded by the genes FADS1 and FADS2 (fatty acids desaturase 1 and 2), respectively. These genes build a gene pool on chromosome 11 with a third gene desaturase, FADS3. In several gene association studies, it has been found that single nucleotide polymorphism (SNPs) in the FADS gene pool is highly associated with LC-PUFA and lipid levels in different tissues, for proper development and health in prenatal and lactation life. For this reason, the analysis of genetically determined differences between individuals in the mother's fatty acid levels during pregnancy and lactation is of particular importance to understand and thus improve the fatty acid supply of lactating.

Statistical Analysis

The data were analyzed statistically using the Statistical Analysis System–SAS (2012) program to study the effect of genetic manifestations of FADS1 genes on the traits studied according to mathematical models, and the significant differences between the averages were compared using the Duncan (1955) polynomial test in light of the application of the least square means method.

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Y_{ijklm}: Viewing value.
μ: The general average of the trait.
$FADS1_i$: Effect of multiple genetic manifestations FADS1 .
A_j: Age effect.
S_k: The effect of gender.
e_{ijkl} : Random error that is distributed naturally with an average of zero and a variance of $\sigma^2 e$.
Gene frequency calculated according to the Falconer and Mackay (1996) equation for each gene.

$$PA = \frac{2 * \text{No. of Homozygous} + 1 * \text{No. of Heterozygous}}{2 * \text{Total number of samples}}$$

First: Gene Frequency: PA
Since: P + q = 1 then the frequency of the second gene is: qB = 1 – PA

RESULTS AND DISCUSSION

DNA extraction

DNA was extracted as a first step to extract the FADS gene using the diagnostic kit (Kit) and it was confirmed that the extraction process was successful by migrating all the samples electrically on the lacrose gel and as previously described and the migration product was imaging to confirm the presence of DNA.

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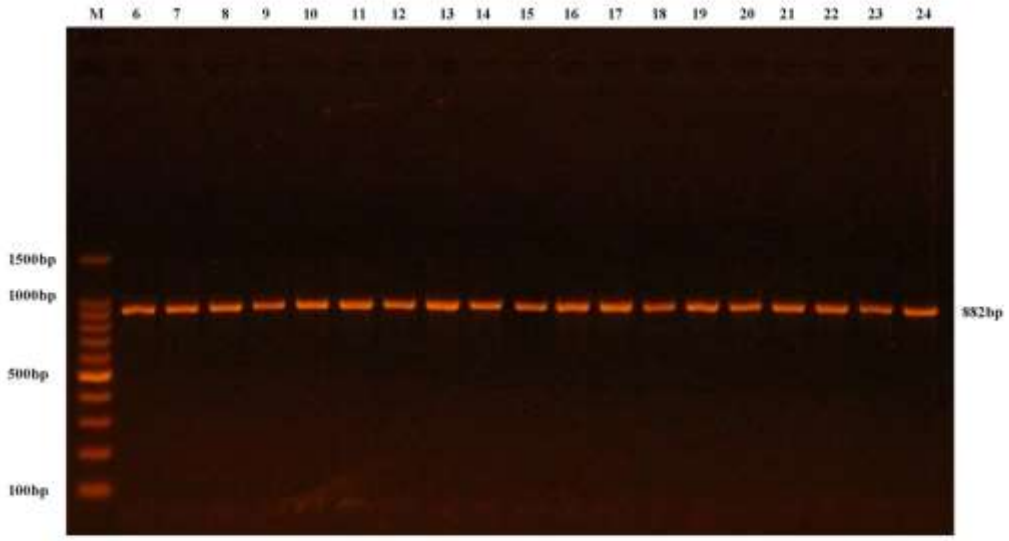

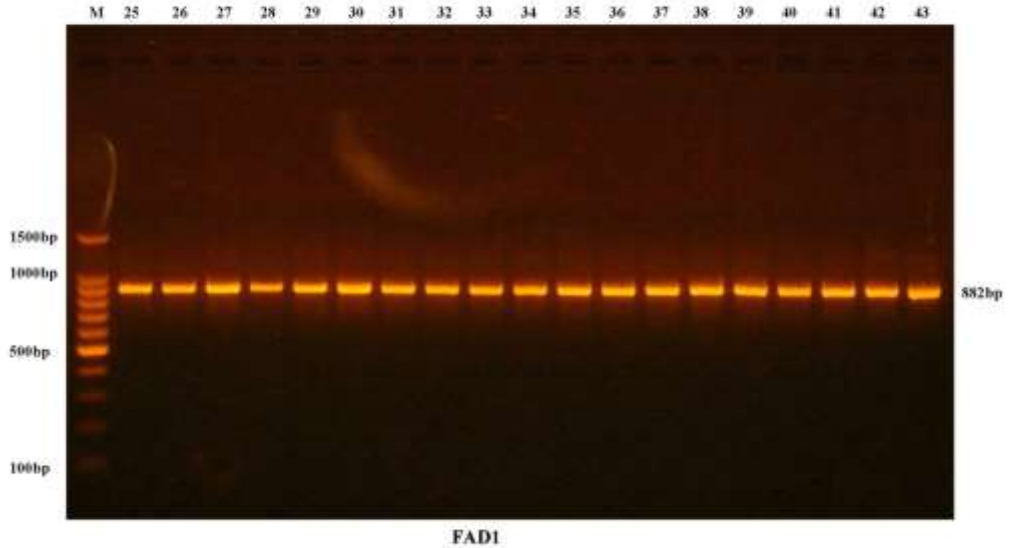

Studied pieces of the FADS1 gene

The results of the current study using DNA sequencing technology showed the presence of a number of mutations in the studied regions of the FADS1 gene and that the mutations detected were all registered with an identification number in the genebank (NCBI) and (ensemble).

From the results of the electroplating of the products of the polymerase chain reaction, it was found that there were three mutations in the samples of the Cypriot goats as shown in Table (1).

Location	Genotype		
	Wild	Hetero	Mutant
C10443T	CC	CT	TT
G10647C	GG	GC	CC
G10771A	GG	GA	AA

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Percentages, number, and gene frequency of mutation C10443T

It is clear from Table (2) that the proportions of the genotypes in the mutation (C10443T), namely wild, hetero and mutant in Cypriot goats (CC: 36.67, CT: 36.67 and TT: 26.66) respectively, and it is clear that there is no significant difference between the proportions of the genotypes of the Cypriot goat breed.

Table (2) Percentages of genotypes and gene frequency of mutation C10443T

Breed	Genotype	Number	Percentages	Significant χ^2	Gene frequency
Cypriot	CC	11	36.67	N.S2.733	C = 0.55 T = 0.45
	CT	11	36.67		
	TT	8	26.66		
	Total	30	100%		

NS :Non-Significant

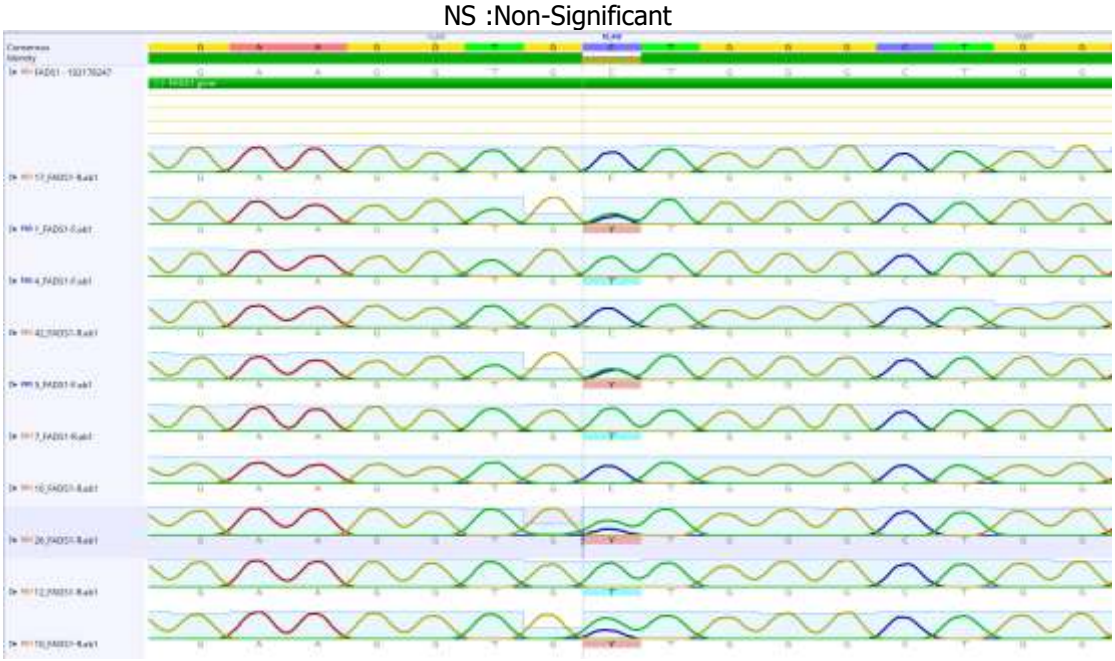

Image (1) The location of the C10443T mutation in the studied piece of the FADS1 gene

C10443T mutation relationship with growth traits

From Table (3) it is clear that there is no significant relationship between the multifaceted variability of the C10443T mutation and the studied growth traits represented by birth weight, weaning weight, mother's birth weight and mother's weaning weight for Cypriot goats.

Table (3) C10443T mutation relationship with growth traits

Breed	Trait	Measurement Unit	Genotype			Significant
			CC	CT	TT	
			14	12	4	
Cypriot	Baby weight	Kg	2.90 ±0.05	2.80 ±0.15	3.02±0.22	n.s
	Weaning weight	Kg	14.00±0.80	13.18±0.64	12.62±0.88	n.s
	Birth weight	Kg	2.86±0.19	3.09±0.17	2.75±0.18	n.s
	Weaning weight	Kg	20.54±0.66	20.18±0.81	19.12±1.02	n.s
	Live weight	Kg	41.90±2.42	40.54±2.82	42.12±2.00	n.s

NS :Non-Significant

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The relationship of the C10443T mutation with milk production and its components

From Table (4) it is clear that there is no significant relationship between the polymorphism of the C10443T mutation with milk production, season length, peak production and milk composition of Cypriot goats.

Table (4) Mutation relationship C10443T Milk production and components

Breed	Trait	Measurement Unit	Genotype			Significant
			CC	CT	TT	
			14	12	4	
Cypriot	Milk production	Kg	234.28±41.10	214.84±37.92	198.11±27.15	n.s
	Season Length	Day	233.09±5.87	231.90±4.22	240.37±5.44	n.s
	Top Production	Day	36.45±2.21	39.81±2.20	36.37±3.12	n.s
	Protein	%	3.02±0.03	3.01±0.03	3.12±0.09	n.s
	Fat	%	3.54±0.36	3.20±0.24	3.41±0.34	n.s
	Lactose	%	4.51±0.11	4.56±0.10	4.55±0.09	n.s
	SNF	%	8.29±0.05	8.22±0.05	8.38±0.24	n.s

NS :Non-Significant

Percentages, number, and gene frequency of mutation G10647C

It is clear from Table (5) that the proportions of the genotypes in the mutation (G10647C), which are wild, hetero and mutant in Cypriot goats are (GG: 16.67, GC: 6.67 and CC: 76.66) respectively, and there were significant differences between the proportions of the genotypes and the gene frequency in wild Cypriot goats G and Mutant C (0.20 and 0.80) respectively.

Table (5) Percentages of Genetic Structures and Gene Frequency of Mutation G10647C

Breed	Genotype	Number	Percentage	Significant χ^2	Gene Frequency
Cypriot	GG	5	16.67	44,13 **	G = 0.20 C = 0.80
	GC	2	6.67		
	CC	23	76.66		
	Total	30	100%		

**P≤0.01

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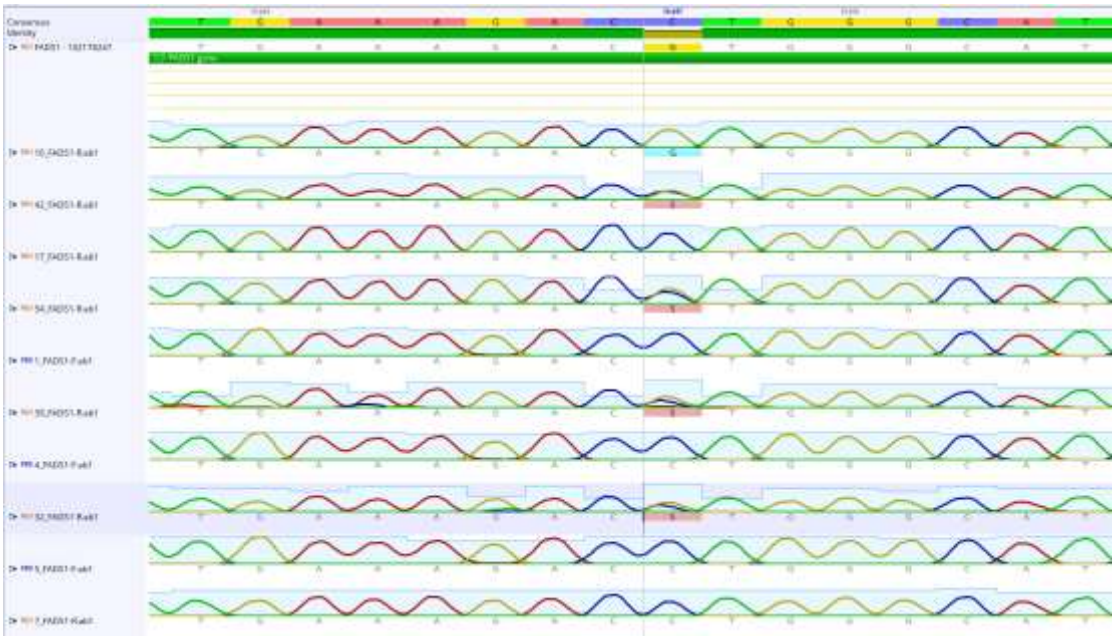

Image (2) G10647C mutation site in the studied piece of the FADS1 gene

The relationship of the G10647C mutation with growth qualities

From Table (6), it is clear that there is no significant relationship between the multiplicity of appearances, the weight of the newborn, the birth weight of the mother and the weight of weaning of the mother, except for the weight of weaning, where the hetero genotype GC outweighed the wild GG and mutant CC genotype, where it was 18.00, 14.00 and 12.78 kg, respectively, as well as live weight, the hetero GC genotype outperformed the mutated CC and GG genotype by 56.50, 41.52 and 35.20 kg respectively, this may be attributed to the type of breeding adopted at the station and the sample size or to the adaptation of the wild gene to environmental factors, and this result is similar to the results of the study of (Kaplanová et al.,2013).

Table (6) Relationship of Mutation G10647C with Growth Traits

Breed	Trait	Measurement Unit	Genotype			Significant
			GG	GC	GG	
			3	8	3	
Cypriot	Baby weight	Kg	2.80±0.09	3.00±0.02	2.80±0.09	n.s
	Weaning weight	Kg	14.00b±1.37	18.00a±1.00	14.00b±1.37	*
	Birth weight	Kg	3.20±0.33	2.75±0.25	3.20±0.33	n.s
	Weaning weight	Kg	20.20±1.01	20.00±2.00	20.20±1.01	n.s
	Live weight	Kg	35.20b±0.20	56.50a±1.50	35.20b±0.20	*

* (P≤0.05) ،Non-Significant:N.S

The relationship of the G10647C mutation with fertility traits and milk production and its components

From Table (7), it is clear that there is no significant relationship between the multiple genetic manifestations of the G10647C mutation, milk production, season length, peak production and milk composition of Cypriot goats.

Table (7): Relationship of mutation G10647C with milk production and its components

Breed	Trait	Measurement Unit	Genotype			Significant
			GG	GC	CC	
			3	8	19	

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Cypriot	Milk production	Kg	173.34±27.44	184.10±69.20	230.01±26.35	n.s
	Season Length	Day	230.60±12.41	241.00±1.00	234.91±2.99	n.s
	Top Production	Day	34.20±2.08	32.00±3.00	38.91±1.68	n.s
	Protein	%	3.09±0.02	3.06±0.14	3.03±0.03	n.s
	Fat	%	3.74±0.53	3.49±0.41	3.29±0.20	n.s
	Lactose	%	4.50±0.25	4.25±0.09	4.58±0.05	n.s
	SNF	%	8.30±0.05	8.12±0.18	8.30±0.08	n.s

NS: Non-Significant

Percentages, number and gene frequency of mutation G10771A

Table 8 shows the proportions of the genotypes in the mutation (G10771A) namely wild, hetero and mutant in Cypriot goats (GG: 10.00, GA: 16.67 and AA: 73.33) respectively, and there were significant differences between the proportions of the genotypes and the gene frequency in wild Cypriot goats G and Mutant A (0.18 and 0.82) respectively.

Table (8) Percentages of genotypes and gene frequency of mutation G10771A

Breed	Genotype	Number	Percentage	Significant χ^2	Gene Frequency
Cypriot	GG	3	10	37,40**	G = 0.18 A = 0.82
	GA	5	16.67		
	AA	22	73.33		
	Total	30	100%		

** (P≤0.01)

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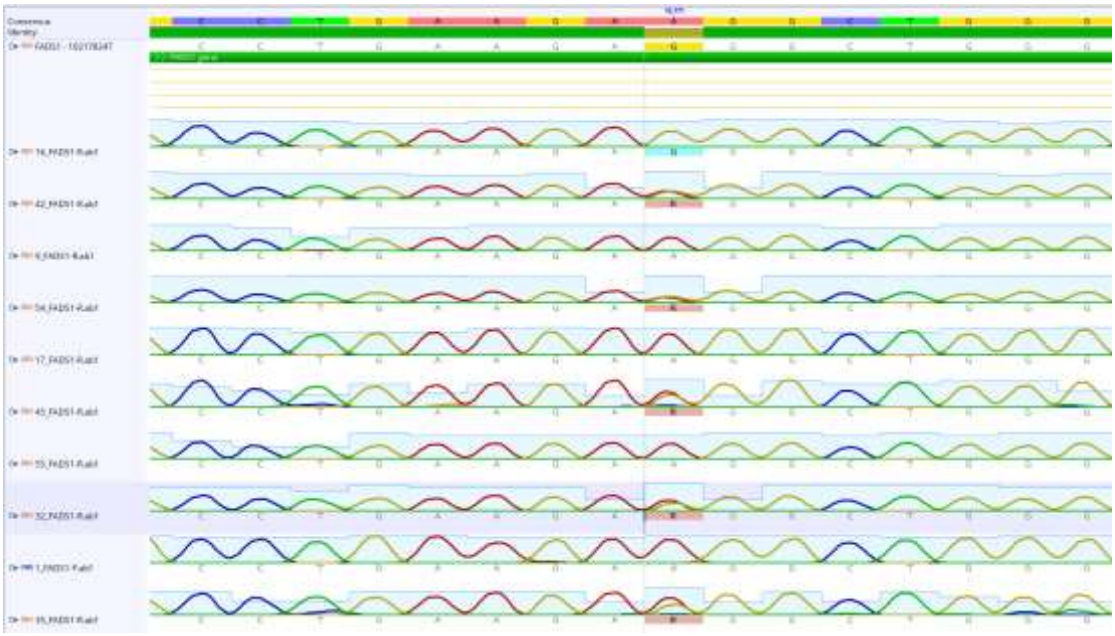

Image (3) Location of the G10771A mutation in the studied piece of the FADS1 gene

The relationship of the G10771A mutation with growth qualities

From Table (9) there is a significant relationship between the multiple genetic manifestations of the G10771A mutation and the weight of the newborn, where the hetero genetic type GA outperformed the genetic structure of the mutant AA and wild GG, where it was 3.40, 2.80 and 2.76 kg, respectively, as well as for the birth weight of the mother, where the wild GG genetic structure outperformed the mutant AA and GA hetero genotype, as it was 3.50, 2.86 and 2.80 kg, respectively, and also there was a significant difference for live weight, where the hetero genetic structure GA outperformed the mutant AA and wild GG, where it was 47.20, 41.00 and 35.33 kg, respectively, while there is no significant relationship between the genetic structures, weaning weight and weaning weight of the mother. Differences between breeds and nutrition, and other genetic factors such as the influence of modified genes (Davis et al.,2006).

Table (9) Relationship of Mutation G10771A with Growth Traits

Breed	Trait	Measurement Unit	Genotype			Significant
			GG	GA	AA	
			2	9	19	
Cypriot	Baby weight	Kg	2.76b±0.14	3.40a±0.24	2.80b±0.08	*
	Weaning weight	Kg	15.00±2.08	14.20±1.01	12.90±0.48	n.s
	Birth weight	Kg	3.50a±0.50	2.80b±0.37	2.86b±0.09	*
	Weaning weight	Kg	19.00±1.04	18.40±1.32	20.54±0.53	n.s
	Live weight	Kg	35.33b±0.33	47.20a±4.23	41.00ab±1.56	*

* (P≤0.05), Non-Significant: N.S

The relationship of the G10771A mutation with fertility traits and milk production and components

Table (10) shows that there is no significant relationship between the multiple manifestations of the G10771A mutation, milk production, season length, peak production and milk composition for Cypriot goats.

Table 10 (Relationship of Mutation G10771A with Milk Production and Milk Components

Breed	Trait	Measurement Unit	Genotype			Significant
			GG	GA	AA	

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			2	9	19	
Cypriot	Milk production	Kg	153.60±43.25	209.34±44.26	228.08±26.56	n.s
	Season Length	Day	222.00±20.50	237.00±10.58	235.77±2.32	n.s
	Top Production	Day	31.33±1.45	39.60±4.15	38.09±1.61	n.s
	Protein	%	3.09±0.05	3.18±0.11	3.00±0.03	n.s
	Fat	%	3.17±0.37	3.73±0.49	3.33±0.21	n.s
	Lactose	%	0.25 ±4.22	0.15 ±4.52	0.06 ±4.59	n.s
	SNF	%	0.08 ±8.37	0.32 ±8.39	0.06 ±8.26	n.s

NS: Non-Significant

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