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The relationship of YAP gene polymorphism with some characteristics of local goats in Al-Muthanna Governorate

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Abstract:

This study was conducted at the Postgraduate Laboratory / Department of Animal Production, College of Agriculture, University of Al-Muthanna, from October 12, 2024, to February 12, 2025. A total of 46 three-month-old male local goats were used in the experiment. Blood samples were collected from the animals at the beginning and end of the trial. Some of the partial tests were also conducted at the Marshes Research Center Laboratory, affiliated with Thi Qar University. The study aimed to investigate the relationship between Polymorphism of the YAP (576T>A) gene and the characteristics of local goats reared in Al-Muthanna Governorate. the results of the YAP (576T>A) polymorphism, showed no significant differences in initial body weights and body dimensions. However, there were significant differences ($P \leq 0.05$) in final body dimensions, particularly in abdominal girth and breast height, which were 67.88 cm for TA and 71.03 cm for TT genotypes. The TA genotype also had significantly higher breast height than the TT genotype. There were no significant differences in biochemical parameters. Regarding hormones, no significant differences were found except for growth hormone, where the TT genotype was significantly higher ($P \leq 0.05$) than the TA genotype. Blood traits showed no significant differences, except for hemoglobin, where the TA genotype was significantly superior ($P \leq 0.05$) to the TT genotype.

Keywords: Polymorphism, YAP (576T>A) gene, local goats, Al-Muthanna Governorate.

Introduction:

Goats are widespread in the local governorates, and the primary factor in their rearing is grazing and agricultural waste, along with flocks of

sheep that share them. Local goats are small in size, produce moderate milk, are highly active, and can withstand harsh environmental conditions and high temperatures. They are a summer favorite (Darwish, 1987). Goats contribute up to 19.9% of the national income from ruminant production, heat stress is one of the most challenging stressors for goat farming, given the changing climate worldwide due to global warming (El-Tarabany *et al*., 2017).

The purebred local goat breeds are the local black goat, the hybrid goat, and the merganser goat (FAO, 2000). Alkass (2012) indicated that merganser goats are raised for their soft fur and are smaller than local goats. Juma *et al.* (2011) indicated that the local goat breed is the second most hairy.

YAP (Yes-Associated Protein 1) plays an important role in regulating cell growth, proliferation, and tissue formation. It is also part of the Hippo signaling pathway, which controls organ size and tissue homeostasis. YAP1 functions in regulating body growth. A recent study found five deletion and insertion mutations (Indels) in the gene in goat breeds such as Guanzhong and Shanbei White Cashmere. These mutations were also shown to be associated with growth traits such as breast depth, weight, and height. This gene affects physical traits (Zhang *et al*., 2024). The circulating gene Circ003429 was found to regulate the synthesis of polyunsaturated fatty acids in the mammary glands of goats by interacting with mir-199a-3p, which affects gene expression (Jiao *et al*., 2022). A study showed that miR-30e-5p regulates fatty acid metabolism in goat mammary gland cells by targeting the gene, which indicates the gene's role in regulating lipid metabolism (Chen *et al*., 2016).

Materials and Methods:

This study was conducted at the First Agricultural Research and Experiment Station of the College of Agriculture, Al-Muthanna University, located in the Umm Al-Agaf area, 12 km southwest of Samawah, from October 12, 2024, to February 12, 2025, to investigate the relationship between polymorphism of the YAP (576T>A) gene and the traits of local goats. Forty-six male local goats were used in the experiment.

The experiment used 46 male local goats, three months old and weaned, purchased from local markets. The animals were numbered. The animals were housed in semi-open and partially exposed pens (35% covered and 65% open), allowing sunlight to enter. At the start of the experiment, body measurements (breast circumference, abdominal circumference, breast height, withers height, body length, body temperature, and body weight) were taken every two weeks. Air temperature and humidity were also recorded. Blood samples were taken

from the goats. Part of the tests were conducted in a laboratory in Muthanna Governorate. The other part of the tests were conducted in the laboratory of the Marshlands Research Center, affiliated with Thi Qar University, for the purpose of isolating and purifying DNA. A group feeding system was used, with the animals fed two meals per day.

Blood samples were drawn from the jugular vein of the goat by manually compressing the neck to locate the jugular vein. A sterile 10 ml syringe was then inserted. The samples were divided into two parts: the first and second, each containing 5 ml samples. The first part of the samples was placed in tubes containing an anticoagulant (Ethylene Diamine Tetra Acetic Acid). The second part was placed in tubes free of the anticoagulant.

Deoxyribonucleic Acid (DNA) Extraction: DNA was extracted from the blood according to the kit instructions provided by the Korean company Geneaid. The DNA was then electrophoresed.

After starting to detect the extraction process (Total-DNA), the extracted samples were transferred to agarose gel at a concentration of (1%), i.e. 1 gm of agarose was dissolved in 100 ml of diluted TBE solution X1, then heated using a Hot Plate for (155) minutes until a clear color was obtained. Then 2 microliters of Diamondrm Nucleic Acid Dye were added to it and left to cool slightly, then the gel was poured into the transfer basin for the purpose of solidification. After the gel solidified and the comb was lifted, 5 microliters of DNA were added, then the electrodes were connected to the power supply, and the appropriate electric current strength for the transfer was established, then the gel was examined with a data documentation device.

5 microliters of DNA were mixed with 2 microliters of loading dye prepared by Promica, USA, in addition to 15 microliters of DiamondTM Nucleic Acid Dye also prepared by Promica, USA, and diluted with TE at a dilution ratio of (1) microliter of dye to 125 microliters of TE solution. The mixture was mixed well using a micropipette on a plastic strip (Laboratory Film). Then, the samples were loaded into the holes of the prepared acarose gel. After loading all the samples into the holes, the transparent plastic cover was placed and the electrodes were connected to the power supply (Power Splay) using 70 volts for 85 milliamps for half an hour. The acarose gel was examined after the migration time had ended using a UV Gel Documentation device, and migration images were taken using the camera installed and designated for this purpose.

Table (1) Primer sequences of the YAP gene.

segment icon	Primer	segment size	Bonding temperature (°C)	
YAP	F: 5' – GCCGCCACCAAGCTAGATAA - 3' R: 5' - ATAGCTGTCCCAAGCTACAAG - 3'	883	58	New design

Results and Discussion

Table (2) showed that no significant differences between body weights in goats with polymorphisms. The results from this mutation at position 576 of the studied segment of the YAP gene on the body weights of local goats were significant for initial and final weight, total weight gain, and daily weight gain. The results for the TT and TA genotypes were 14.26 and 14.54 for initial weight, 30.21 and 29.45 for final weight, 15.95 and 14.90 for total weight gain, and 0.13 and 0.12 for daily weight gain, respectively. This may be due to the small number of animals used in the experiment and the lack of variation in rearing conditions. The results were agreed with Aboul-Naga *et al.* (2023) in a study on local Egyptian goats.

Table (2) The relationship between the polymorphisms of the YAP (576T>A) gene and body weights (kg) of local goats (mean ± standard error).

Polymorphisms	Animal No.	Initial weight	Final weight	Total weight gain	Daily weight gain
TT	**29**	14.26±0.13	30.21±0.3	15.95±0.34	0.13±0.002
TA	**17**	14.54±0.14	29.45±0.45	14.90±0.41	0.12±0.003
Sig.		N.S	N.S	N.S	N.S

Table (3) indicates that there were no significant differences between the initial body dimensions of goats with different Polymorphisms. The results of this mutation at position 576 of the studied segment of the YAP gene on the body dimensions of local goats were significant for body length, breast circumference, belly circumference, breast height, and rump height. The body lengths of animals carrying the TT and TA Polymorphisms were 58.13 and 59.05, breast circumference 60.44 and 60.58, belly circumference 63.65 and 64.52, breast height 50.68 and 49.58, and rump height 52.96 and 53.88, respectively. While significant differences (P≤0.05) were found between the final body dimensions of goats with Polymorphisms resulting from this mutation at position 576 of the studied segment of the YAP gene in the body dimensions of local goats, there were no significant differences in body length, breast circumference, and rump height. The body lengths of animals carrying the TT and TA genotypes were 70.55 and 72.41, breast circumference 70.37 and 71.47,

and rump height 64.51 and 66.82, respectively. As for abdominal circumference and breast height, there were significant differences (P≤0.05). The TT and TA genotypes were 71.03 and 67.88, respectively, in abdominal circumference and breast height, and 62 and 66.88, respectively. This may be due to the small effect of the gene studied in the experiment, or to the greater environmental influence than the genetic influence. Or the sample may be small, agree with Lin (2020) in their study of the Hippo-YAP signaling pathway in farm animals, and Al-Khafaji (2022) in their study of the relationship between genetic polymorphisms of the leptin and prolactin genes and some productive traits in Awassi sheep.

Table (3) The relationship between polymorphisms of the YAP gene (576T>A) and the initial and final body dimensions (cm) of local goats (mean ± standard error).

	Polymorph.	Animal No.	Body length	Breast circumference	Abdominal circumference	breast height	Rear height
Exp. beginning	TT	29	58.13±0.85	60.44±1.009	63.65±1.02	50.68±1.04	52.96±1.19
	TA	17	59.05±1.17	60.58±1.04	64.52±1.05	49.58±1.79	53.88±2.44
Sig.			N.S	N.S	N.S	N.S	N.S
Exp. end	TT	29	70.55±0.95	70.37±0.96	71.03±0.81 a	62.00±1.2 b	64.51±0.86
	TA	17	72.41±0.69	71.47±1.12	67.88±1.01 b	66.88±1.38 a	66.82±1.11
Sig.			N.S	N.S	*	*	N.S

Table (4) shows no significant differences between animals carrying the TT and TA polymorphisms. The results of this mutation at position 576 of the studied segment of the YAP gene were in the biochemical blood parameters of local goats. Total protein, albumin, globulin, low-density lipoprotein, and high-density lipoprotein were present. The results for the TT and TA polymorphisms were 5.67 and 5.69 for total protein, 2.98 and 3.06 for albumin, and 2.71 and 2.62 for globulin. High-density lipoprotein was 31.79 and 31.05 for high-density lipoprotein, and 15.51 and 14.17 for low-density lipoprotein, respectively. This may be due to the indirect effect of the YAP gene on biochemical parameters. Biochemical parameters are affected by several different genes and other factors, and the results agreed with Kareem and Hadi (2022) in a study on local Iraqi goats.

Table (4) The relationship between polymorphisms of the YAP gene (576T>A) and the blood biochemical parameters of local goats (mean ± standard error).

Polymorphisms	Animal No.	T. Protein dl) / gm)	Albumin dl) / gm)	Globulin dl) / gm)	LDL dl) / mg)	HDL dl) / mg)
TT	29	5.67±0.1	2.98±0.08	2.71±0.05	15.51±1.4	31.79±1.3
TA	17	5.69±0.13	3.06±0.06	2.62±0.07	14.17±1.35	31.05±0.68
Sig.		N.S	N.S	N.S	N.S	N.S

Table (5) shows that there are significant differences (P≤0.05) between the hormones in goats with polymorphisms. The results of this mutation at position 576 of the studied segment of the YAP gene in the hormones of local goats in the enzymes AST and ALT. There were no significant differences, as the results for the TT and TA polymorphisms for AST were 70.96, 68.47, and ALT were 16.79, 23.08, respectively. As for G.H, there were significant differences (P≤0.05), as the TT and TA polymorphisms for G.H were 0.03, 0.02, respectively. This may be due to the small sample size, environmental or gene interference, or the mutation being studied does not have a direct effect on growth hormone, or may be due to the mutation being weak or silent, agreed with Wang *et al.* (2017) in a study on Chinese goat breeds.

Table (5) The relationship between polymorphisms of the YAP gene (576T>A) and hormones in local goats (mean ± standard error).

Polymorphisms	Animal No.	AST (IU/L)	ALT (IU/L)	G.H (ng/ml)
TT	29	70.96±3.32	16.79±2.61	0.03±0.0005 a
TA	17	68.47±5.004	23.08±3.93	0.02±0.0005 b
Sig.		N.S	N.S	*

Table (6) indicates significant differences (P≤0.05) between the blood traits of goats with polymorphisms resulting from this mutation at position 576 of the studied segment of the YAP gene in the blood traits of local goats. There were no significant differences in the blood traits of red blood cells, red blood cell volume, mean cell volume, mean hemoglobin percentage, and white blood cells. The results for the TT and TA polymorphisms were 0.92, 0.96 for red blood cells, 3.77, 4.05 for red blood cells, 43.8, 43.76 for mean hemoglobin percentage, 99.36, 106.76 for mean hemoglobin, and 23.92, 25.32 for white blood cells, respectively. There were significant differences (P≤0.05) in hemoglobin. The TT and TA genotypes for hemoglobin were 7.96 and 8.77,

respectively. This may be due to the influence of health or environmental factors (Al Salman and Al-Gharawi, 2019), or it may not directly affect the genes associated with blood cell formation, this is consistent with Zhou (2018) in a study on hematological parameters in goats.

Table (6) The relationship between polymorphisms of the YAP (576T>A) gene and blood traits in local goats (mean ± standard error).

Polymorphisms	Animal No.	RBC 10^{12}/L	HB gm/ dL	HCT %	MCV fL	MCH pg	WBC 10^{9}/L
TT	29	0.92±0.05	7.96±0.14 b	3.77±0.24	43.8±0.27	99.36±4.45	23.92±0.7
TA	17	0.96±0.07	8.77±0.35 a	4.05±0.35	43.76±0.27	106.76±5.36	25.32±1.15
Sig.		N.S	*	N.S	N.S	N.S	N.S

Table (7) indicates significant differences (P≤0.05) between the heat tolerance coefficients in goats and polymorphisms. The results of this mutation at position 576 of the studied segment of the YAP gene on the heat tolerance coefficient of local goats. The heat tolerance coefficient at the beginning of the experiment was 96.11, 96.08, and the temperature and humidity index was 67.32, 63.55. There were no significant differences. The results were for the TT and TA polymorphisms, respectively. As for the heat tolerance coefficient at the end of the experiment, there were significant differences (P≤0.05). The TT and TA polymorphisms for the heat tolerance coefficient were 95.82, 94.14, respectively. This may be due to the animal being exposed to environmental conditions and imbalances. The results are similar to those found by Sejian *et al*. (2019) in a study on the impact of climate on livestock.

Table (7) The relationship between polymorphisms of the YAP (576T>A) gene and the heat tolerance coefficient (m) and the temperature and humidity index (m) for local goats (mean ± standard error).

Polymorphisms	Animal No.	T.T.C. at experiment beginning	T.T.C. at experiment end	THI
TT	29	96.11±0.15	95.82±0.49 a	67.32±1.48
TA	17	96.08±0.22	94.14±0.6 b	63.55±2.53
Sig.		N.S	*	N.S

Figure (1) indicates that there were no significant differences between animals carrying the TT and TA polymorphisms. Results from this mutation at position 576 of the studied segment of the YAP gene with cortisol were found. Cortisol levels in goats were 241.65 and 369.35 for animals carrying the TT and TA polymorphisms, respectively. This may be due to the fact that this gene plays an important role in stress response, agreed with Sejian (2018) in a study on the adaptation of sheep production to climate change, and Al-Mutairi (2022) in a study on the relationship between the genetic markers Cyp21 and Bmusos and some productive and physiological traits of Holstein Friesian cattle.

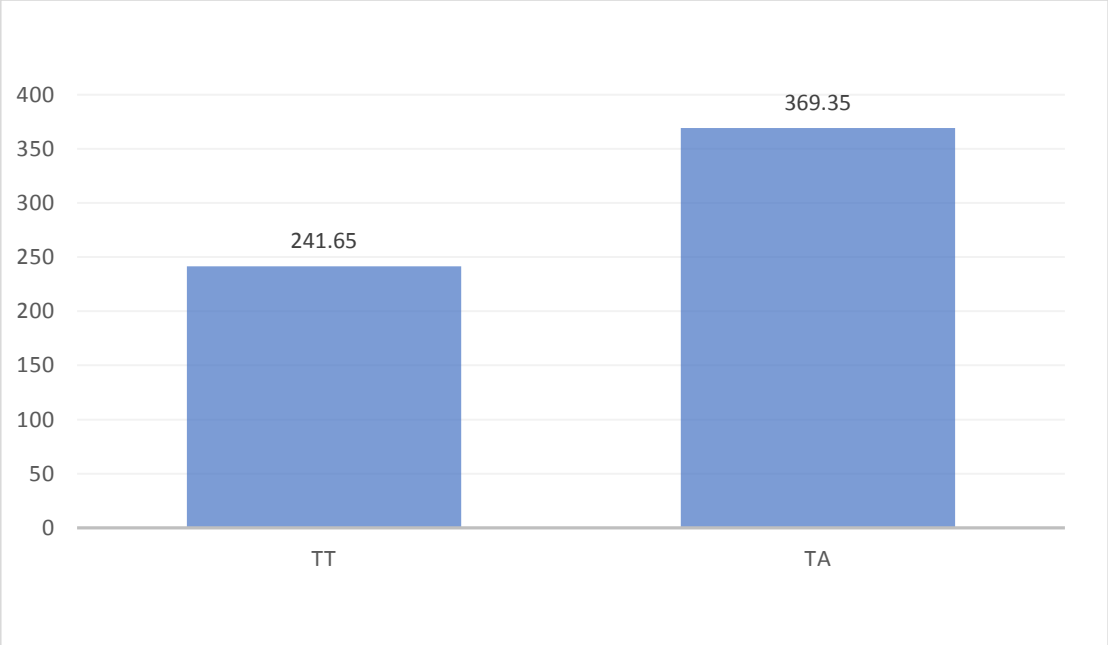

Figure (1) Cortisol hormone level for polymorphisms of the YAP gene (576T>A) and cortisol hormone concentration in local goats.

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