

Role of Sex Chromatin on Performance in the Crossbred Cows

دور الكروماتين الجنسي في الأداء الإنتاجي للأبقار المضرّبة

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Abstract

This study was conducted on a total of 67 crossbred cows in Erbil plain during the period from July/ 2014 to April / 2015, to study the role of sex chromatin shapes (Drum stick, Sessile nodule, Tear drop and Small club) on Daily Milk Yield (DMY), Lactation Period(LP), fertility rate and fertilize estrous sequences. We also study the effect of age of cows on the DMY, LP, and fertility and fertilize estrous sequences. The overall means of sex chromatin shapes drum stick, sessile nodule, tear drop shape and small club were 25.0 %, 35.0 %, 22.0 % and 18.0%, respectively. While the overall means of (DMY), LP, fertility rate and fertilize estrous sequences were 23.99kg, 197.46 days, and 87.13% and 1.54, respectively. The results showed that there is a significant ($p \leq 0.05$) different in relation to DMY, the highest rate of DMY showed among the cow, arise sex chromatin drum stick (28.86kg), lactation period (203.57), the small rate of DMY was low rate among the cows which arise sex chromatin tear drop and LP (192.63days). Significant effect of ages of cows on the patterns of sex chromatin had been observed. It was concluded from this study that the prediction of production milk production and reproduction (fertility rate and fertilize estrous sequences) performance of crossbred cows from shapes and percentage of sex chromatin distribution and measurements. The sex chromatin shapes in doing early selection the elite individuals on the linkage between sex chromatin shapes and performance production.

Key word: Crossbred cows, Sex chromatin, Milk yield, Repeatability and Correlation coefficient

المخلص

أجريت هذه الدراسة على الأبقار المضرّبة في إحدى القطعان الأهلية- ناحية قوشتبنة / أربيل-أقليم كوردستان العراق لـ67 بقرة مضرّبة من المدة تموز / 2014 لغاية نيسان / 2015. بهدف دراسة دور الكروماتين الجنسي في إنتاج الحليب اليومي و الكلي وطول موسم الحليب ونسبة الخصوبة و الخصب و وزن الميلاد و تسلسل دورة الشبق في الأبقار المضرّبة، بلغت النسب المنوية لعصا الطبال و بروز بدون ساق و دمعة العين والشكل الهرأوي % 26.0 و % 35.0 و % 20.0 و % 519.0 على التوالي، أما قيمها لمحصول الحليب اليومي و طول مدة الحلب و نسبة الخصوبة و تسلسل دورة الشبق فقد بلغت 23.99 كغم و 197.46 يوم و 87.13% و 1.54 على التوالي. تبين أن هنالك تأثير معنوي لأشكال الكروماتين الجنسي في جميع الصفات المدروسة. و أظهرت نتائج الدراسة الحالية وجود فروق معنوية ($P \leq 0.05$) في معدل إنتاج الحليب اليومي، وبلغ أعلى معدل لإنتاج الحليب اليومي لدى الأبقار التي ظهر فيها الكروماتين الجنسي من نوع عصا الطبال (28.86 كغم)، في حين كان معدل إنتاج الحليب اليومي في أدناه لدى مثيلاتها التي ظهر فيها الكروماتين الجنسي من نوع دمعة العين (16.21 كغم) كان معامل الارتباط موجبا إذ بلغ 0.25، 0.011 و 0.11. بين إنتاج الحليب اليومي وأشكال الكروماتين الجنسي (لعصا الطبال و بروز بدون ساق و دمعة العين والشكل الهرأوي) على التوالي. تم تقدير المعامل التكراري لإنتاج الحليب اليومي، إذ ان معرفة أشكال الكروماتين الجنسي لها دور في الانتخاب المبكر للأبقار المضرّبة المتميزة من خلال الربط ما بين أشكال الكروماتين الجنسي والأداء الإنتاجي والتناسلي في الأبقار المضرّبة.

الكلمات الدالة: الأبقار المضرّبة، الكروماتين الجنسي، محصول الحليب، المعامل التكراري و معامل الارتباط

Introduction

Cyto-genetic studies are very important tool in proper understanding of the pathogenesis of numerous problems in livestock industry. These include some X- related infertility or sub-fertility, embryonic and fetal deaths, cases of abnormal sexual development and intersexuality as well as hybrid sterility or compatibility test for hybridization [1]. One of such methods adopted in cyto-diagnostic studies for chromosomal assessments and fertility predictions is X Chromatin evaluations. Assessment of the sex or x-chromatin in animal is based on the promise that it represent the sexual statues (XX or XY i.e. sex chromosomes) of that particular. Animal could have an abnormal sexual make-up and thus abnormal sex chromosomes. The X-chromatin can be found anywhere on the nucleus jutting slightly from the tip of the main nucleus to form the sex chromatin bodies.

Typical female X-chromatin body in the polymorph nuclear neutrophils (PMNS) of cattle, buffaloes and goats appears as a drumstick attachment to a thread similar to that found in human PMNS. The X-chromatin can be found anywhere on the nucleus jutting. However, structural abnormalities of the X-chromosome have been reported to affect the size and shape of the X-chromatin [2]. Drumsticks tend to be larger than usual in females carrying one normal and one large X chromosomes (xX). It has been reported that sex chromatin abnormalities in cows is associated. During the last few years much emphasis has been laid on the cytogenetic assessment of humans reproductive efficiency by examining the sex chromatin patterns in their blood smear however, the reports elucidating the relation of fertility, in fertility with sex chromatin attributes in various farm animals are sporadic [3]. Repeatability is an important genetic parameter, frequently used to measure the ability of the animal to repeat its level of production at successive intervals in time. The X-chromosome markers can successfully be used in rabbits to predict the cytogenetic or genetic merits of various economically important species [4].

The purpose of this work was to study the effect of shape of sex chromatin in the crossbred cows affecting daily milk yield, lactation period, and fertility rate and fertilize estrous sequences, also repeatability of the daily milk yield and correlation coefficients between the studied traits in the crossbred cows.

Materials and Methods

The study was conducted on a total of 67 crossbred cows in Erbil plain for the period from July/2014 to April /2015. They were kept under a fairly good management and both concentrated and green foods were available along with water *ad libitum*. Forage consisting of alfalfa provides fodder center for cows milking, based on the daily milk yield and usually have a mean of 1 kg per 2-2.25 kg milk, and containing diet bran, barley, and subject cows to a health program, and vaccinates cattle against occasional anthrax, anthrax and mastitis is checked after washing and milking process by twice a day (morning and evening). Blood collection and blood smear preparation and examination, blood samples were collected by using heparin zed vacuonier tube to avoid, coagulation and properly tagged for proper identification, a drop of the whole, blood was dropped in a clean glass slide using a Pasteur pipette and a smear made, two slides were made from each sample and allowed to dry. The slides were stained with Leishman stain for (3-5) minute after that washed with distilled water, and then air dried; the slides were examined under the Microscope at a magnification of 100 x objective using oil immersion. The polymorph nuclear neutrophils were examined for sex chromatin of different shapes (drum stick, sessile nodule, tear drop, small club), were counted in (100), polymorph nuclear leucocytes animals.

Repeatability estimate was obtained as follows = $\delta^2d / \delta^2d + \delta^2e$

Repeatability was estimated for daily milk yield.

δ^2d = Variance component of cow

δ^2e = Residual error term, a (General Linear Model) GLM used for the statistical analysis of the data Duncan multiple range test [5] was performed for the mean differences comparisons. A procedure of the statistical analysis system [6] was used according to the following linear additive model:

$$Y_{ijk} = \mu + S_i + A_j + e_{ijklm}$$

Y_{ijk} is the value of any observation in the study.

μ : Overall mean

S_i : Effect of i^{th} Sex chromatin i = drum stick, sessile nodule, tear drop and small club.

A_j : Effect of j^{th} Age of cow j = 3.5, 4.5, 5.5 and ≥ 6.5 .

e_{ijklm} : Random error associated with the $ijklm^{\text{th}}$ observation, assumed to be NID. $(0, \delta^2e)$. Chi-square test was used to significant compare between percentages in this study.

Results and Discussion

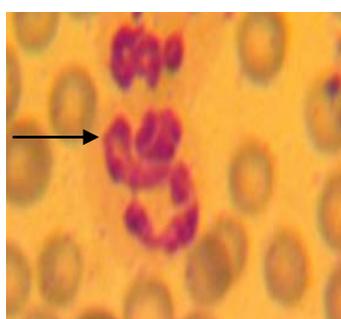
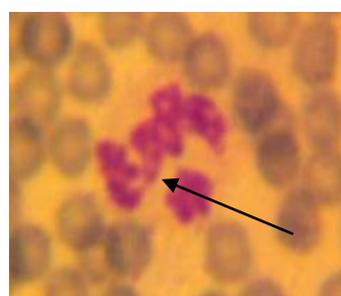
The results of the present study show that there are four shapes of sex chromatin in crossbred cows. Table (1) shows the general mean value of frequency of sex chromatin is 886 distributed in four shapes of sex chromatin (drum stick, sessile nodule, tear drop and small club) with the percentage (25.0, 35.0, 22.0 and 18.0)% respectively, this table showed that the frequency of sessile nodule have high rate than other shapes of sex chromatin while the small club shape have lowest frequency and this results is similar with studies happened in Iraq like [7] on sheep's in this study the highest rate of sex chromatin type sessile nodule which its mean value (64 - 49 %).

Table (1): Numbers and ratio of sex chromatin shapes distributed in the studied trait.

	Type of sex chromatin	No. animal	No. observation	%
1	Drum stick	14	222	25.0
2	Sessile nodule	17	320	35.0
3	Tear drop	17	195	22.0
4	Small club	19	159	18.0
Total	-----	67	886	%100
	Chi-square values χ^2		-----	7.028**

** (P<0.01)

Also our investigation agreed with the study of [8], whom they noticed the highest rate of sex chromatin type sessile nodule which is (49.55%) and lowest rate of sex chromatin in shape small club shape which is (5.06%) ewes. Turkish Awassi sheep. In our study we noticed that the frequency of sex chromatin in all shapes is higher if we compared with other investigation the reason of these results regarded to number of lobes of poly morph nuclear leukocyte of bloods of cows during examination and this agreed with this study [9] sex chromatin. Our study is not similar to study of [10]; in this study highest value of sex chromatin is drum stick (1.89) while the lowest rate of sex chromatin is small club shape is (0.741). Figures (1-4) shows the sex chromatin shapes in Poly morph nuclear leucocyte of cows.

**Fig. (1): Drum stick (100 x)****Fig. (2): Sessile nodule (100 x)****Fig. (3): Small club shape (100 x)****Fig. (4): Tears drop shape (100 x)****Fig. (1-4): The sex chromatin shapes in Polymorph nuclear leucocyte of cows**

The reason of this variation in rates of sex chromatin in studies to another the differences of species of animals, the healthy case of livestock, origin type of breeding method of mating, volume of sample and geographical environment [10]. The mean value of effects of age cows on types of sex chromatin (drum stick, sessile nodule, tear drop and small club shape) (25.0%, 35.0%, 22. 0% and 18.0%) respectively. This table show significant differences of effect of age of cow on occurrence of sex chromatin. Table (2) shows significant (P<0.05) effect of age of cows on occurrence of types of sex chromatin we noticed that highest rate of sex chromatin at age (6.5) years and 5.5 years have percentage 35.0, 24.0 respectively, on the other hand lowest rate of occurrences of sex chromatin in (18.0) in age (3.5) years.

Table (2): Percentage of sex chromatin in polymorph nuclear leucocytes in locally cows at different ages.

Age of cows (year)	Sex chromatin %	Drumstick %	Sessile nodule %	Tear drop %	Small club %
3.5	18.0c	5	4	6	3
4.5	23.0b	6	8	5	4
5.5	24.0b	6	11	3	4
≥6.5	35.0a	8	12	8	7
	100.0	25.0	35.0	22.0	18.0

*Values with different letters indicate a significant difference ($P \leq 0.05$)

Table (3) shows the overall mean of DMY is (23.99) kg and lactation period (197.46). Also shows that there is significant effect ($P < 0.01$) of sex chromatin on the rate of daily milk yield. The highest rate of (DMY) shown among the cows arise sex chromatin in drum stick (28.86) kg, while the rate of (DMY) was in lowest rate among the cows which arise sex chromatin tear drop shape and small club (21.16, 21.18) kg. Also there is significant effect of age. These results similar to study of [10]. The highest frequency of drum stick (2.500) in neutrophil of age 4 year has highest daily milk yield of cow on the patterns of sex chromatin had been observed. The highest rate of (DMY) among the cows at the age of (5.5, 4.5) years old raised high rate of sex Chromatin (drum stick). The lowest rate of DMY among the cow at the age (3.5, 6.5) years old. While there is no significant differences of cows ages on lactation period.

Table (3): Effect of sex chromatin shapes in milk production.

Source of variation	No. animals	No. observation	Daily milk yield (kg)	Lactation period (days)
Overall mean	67	886	23.99±0.06	197.46±0.22
Type of sex chromatin			*	*
Drum stick	14	232	28.86±0.26a	203.57±0.91a
Sessile nodule	17	320	25.94±0.15b	202.94±0.06a
Tear drop	17	157	21.16±0.07c	192.63±0.8b
Small club	19	177	21.18±0.15c	192.35±0.89b
Age of cows (year)			*	N.S
3.5	21	180	22.33±0.15b	197.14±0.72a
4.5	19	191	24.05±0.21a	197.37±0.80a
5.5	11	210	25.09±0.39a	201.82±1.27a
≥6.5	16	305	25.31±0.30a	195.00±0.97a

Values with different letters indicate a significant difference. * ($P \leq 0.05$) N.S Non-Significant.

The reason of increasing daily milk yield with the increasing age of animal to progression and activation of animal udder this also increase the size of digestion canal and increase the digestion of feed which affect milk production. These results were similar to the study by [11] that showed this study shows that the DMY increase with the occurrence the shape of sex chromatin type drum stick and decrease the rate of milk with occurrence of tear drop shape and small club shape. The overall mean of occurrence of types of sex chromatin on rate of fertility and fertilize estrous sequences (87.13 and 1.54) respectively. The highest rate of fertility was seen in cows arise sex chromatin in type drum stick (90), while the lowest rate of fertility was seen in cow with chromatin

Table (4): Effect of sex chromatin shapes on fertility rate and prolificacy.

Source of variation	No. animal	No. observation	% Fertility	Fertilize estrous sequences (time/season)
Overall mean	67	886	87.13±0.04	1.54±0.01
Type of sex chromatin			*	*
Drum stick	14	232	90.00±0.10a	1.10±0.02b
Sessile nodule	17	320	89.00±0.12a	1.20±0.02b
Tear drop	17	157	86.00±0.08b	1.90±0.02a
Small club	19	177	86.00±0.10b	1.90±0.02a
Age of cow (year)			*	*
3.5	21	180	86.43±0.11c	1.70±0.02a
4.5	19	191	87.89±0.13ab	1.40±0.03bc
5.5	11	210	88.64±0.21a	1.30±0.04c
≥6.5	16	305	86.88±0.16bc	1.60±0.03ab

Values with different letters indicate a significant difference. * ($P \leq 0.05$)

in type tear drop shape and small club(86.00) .While the highest rate of fertilize estrous sequences in cows arise sex chromatin in shape (tear drop and small club (1.90,1.90) respectively .Significant effects of ages of cow on the pattern of sex chromatin had been observed on the fertility rate shows in cows age (4.5) year, cows in age (5.5) years old had high rate of fertility (%88.64) and have low rate of fertilize estrous sequence after that age cows in age (4.5) years old had high rate of fertility (%87.89) and fertilize estrous sequence (1.40) .While the lowest rate of fertility shown in cows with age (3.5 and 6.5) years old (%86.4 and % 86.88) respectively and fertilize estrous sequences (1.70 and 1.60) respectively. In our study, it can be indicated that cows which have sex chromatin in type (drum stick) have the high rate of fertility and low rate of fertilize estrous sequences, this similar with the study of [12] in cow drum stick of neutrophil leucocytes was studied on the quantitative and morphological characteristics and evaluated as a diagnostic measure cow freemartin in newborn calves. Our result is not agreed with the study of [7] performance sex chromatin traits they show relationship between sex chromatin traits and performance of 20 male from Damascus goats ,tear drop shape have high rate of fertility (0.08) after that small club(0.06) after that sessile nodule and drum stick at (0.05 and 0.06).These results because fertility rate is one of the most economic factor inbreeding herds this factor measure amount of meat production and the ability of the herd for production and then apply selection programs. During the last few years much emphasis has been laid on the cytogenetic assessment of humans reproductive efficiency by examining the sex chromatin patterns their blood smears however, the reports elucidating the relation of fertility and infertility with sex chromatin attributes in various farm animals are sporadic.(sex chromatin as predictor of genetic merit),in this study we show that cows in age (5.5) years old have high rate of fertility (%88.64) and have low rate of fertilize estrous sequences while cows in age (3.5) years old have low rate of fertility (%86.43) and have high rate of fertilize estrous sequences , and this similar to study of [13] that sex chromatin incidence in Sharabi heifers (6 month old) was 6.9% distributed in 4 shapes (drum stick 2.64%,small club 0.28%,tear drop 1.42%,sessile nodule 2.57%) In the fertile adult cows (4 and 6) years old the incidence was significantly ($p<0.05$) higher than in heifers distributed in four shapes drum stick 4.1 % , small club 0.5 ,tear drop 0.9 ,sessile nodule 3.2 % .The percentage of drum stick and sessile nodule was significantly($p<0.05$) higher than in heifers, also we show that cows in age (6.5) years the fertility lower than cows in age 5.5years(88.64) ,similar to the study [14]. A slight decrease in the incidence of drum stick with increasing age of the individual has been described by [15] .Results in table (5) shows that sex chromatin shapes correlated positively with daily milk yield, fertility rate and prolificacy, daily milk yield correlated positively 0.25, 0.22, 0.11, and 0.11with drum stick, sessile nodule, tear drop shape and small club respectively, also daily milk production correlated positively with fertility 0.44.

Table (5): Correlation coefficient between factors for traits.

Parameter	Drum stick	Sessile nodule	Tear drop	Small club	Daily milk yield	Fertility
Drum stick	1					1
Sessile nodule	0.02	1				
Tear drop	0.03	0.02	1			
Small club	0.02	0.03	0.01	1		
Daily milk yield	0.25	0.22	0.011	0.11	1	
Fertility	0.22	0.18	0.18	0.16	0.44	1

Repeatability

Repeatability of a trait is the proportion of the phenotypic variance that is due to all genetic effects and permanent environmental effects. It is an indicator of effectiveness of selection on early lactations. Repeatability estimates for daily milk yield 0.48. The high estimates of repeatability in this study means that one could cull poor producing individuals on the basis of their first record. While a high repeatability coefficient does not mean that the animal will demonstrate the same performance in the next productive seasons, it can predict the subsequent performance of the animal under stable environmental conditions [16].

Conclusion

Sex chromatin shapes had significant effect on all of the characterizes studied, from this study we get a result that the sex chromatin in cow is not the same, and have a great role and effect statistically on fertility rate. Correlation of coefficient value between daily milk yield correlated positively with all sex chromatin shapes .The high estimates of repeatability in this study means that one could cull poor producing individuals on the basis of their first record. It was concluded from this study prediction of production (milk yield) and reproduction (fertility rate and fertilize estrous sequences) performance for crossbred cows from shapes and percentage of sex chromatin distribution and measurements. The sex chromatin shapes helped to doing early selection the elite individuals on the linkage between sex chromatin shapes and performance production.

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References

1. Ajuogu, P.K., yahaya M.A. and Ndubuisi N.P. (2014). The X_Chromatin Barr Bodies. Status and Differential White Blood Cell Count of the Nigerian Indigenouse Trade Bull Cattle Breeds. *J. Anim. Sci. Adv.* 4(5):812-816.
2. Monre, W.S. (1996). *Genetics*, (3rd edition), prentice Hall, India New Delhi.
3. Shanker, V. and Bhatia, S. (1983). Utility of sex chromatin predictor of genetic merit in animal production A Review World review of Animal production, vol, XIY, NO.I.
4. Nyeche, V.N., Owen, O.J. and Ndor, L. (2010). X-chromatin status of rabbits selected farms in Port Harcourt Nigeria Department of Animal Science, Rivers state P.M.B 5080, PART Harcourt. Nigeria.
5. Duncan, D.B. (1955). Multiple range and Multiply F. tests. *Biometrics*. 11:1-42.
6. SAS. (2012). *Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed.* SAS. Inst. Inc. Cary. N.C. USA.
7. Al-Jabury, A.R. and Al-Rabeay, H.M. (2013). The role of sex chromatin in some blood parameters and prolificacy in Damascus goats. *Karbala scientific journals*. 3: (1):57-68. (Arabic).
8. Al-Anbari, N.N. and Al-Khazragi, W.J.M. (2012). The Role of Sex Chromatin in performance of Turkish Awassi sheep. *Journal of Science*. 5 (1):173-180. (Arabic).
9. Davidson and smith, D.R. (1954). A morphological sex difference in the poly morphonuclear neutrophilleucocyte *Brit. med. J.*, 2.
10. Ameen, N.A. and Raoof, S.O. (2015). The effect of sex chromatin on some reproductive traits of local sheep in Erbil. *Biotechnology Research Center. Al-Nahrain Univ. Baghdad. Iraq* 9 (2): 6-10. (Arabic).
11. AL-Khazragi, W.j.m. (2011). Role of sex chromatin and cytoplasmic inheritance in performance of Turkish Awassi Sheep, PhD. Thesis, Agriculture College. Baghdad University.
12. Shekin, J., Tamura, S., Teraishi, T. and Oura, R. (1992). Evaluation of sex chromatin of calves neutrophils as diagnostic tool for Bovine freemartins at their early life. Department of veterinary, Tottori 680, Japan.
13. Al-Janabi, A.S. and AL. Essawi, M.A. (2010). Sex chromatin picture in sharabi cows in Iraq. *Al-Anbar J. Vet. Sci.*, 3 (1): 110-114.
14. Med, J.G. (1964). Sex chromatin (Review article). from Patton laboratory University College, London. Downloaded from jmg-bmj.com on August 29, 2014-published by group bmj.com.
15. De Castro, N. M. (1963). Frequency variations of "drumsticks" of peripheral blood neutrophils in the rabbit in different alimentary conditions. *Acta anat. (Basel)*. 52, 341.
16. Mourad, M. (2001). Estimation of repeatability of milk yield and reproductive traits of Alpine goats under an intensive system of production in Egypt. *Small Rumin. Res.* 42.1-4.