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The effect of age on milk production, its components, and some blood parameters in bred Friesian crossbreed cows raised in southern Iraq

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Abstract

The present study was carried out between October 1, 2023 and June 1, 2024 in the village of Al-Awad, district of Al-Shattra in the Thi Qar governorate of Iraq. The purpose of the research was to assess how different types of cow's age influenced both daily and cumulative yield and how this would subsequently impact certain hematological parameters; RBC count, hemoglobin amount, hematocrit, platelet count and WBC count. A total of 30 mixed breed female Friesian cattle (Friesian-x-Al Janobi) in three different groups each containing 10 animals were used for this experiment. Group one were 2 to 4 year old females; group two were 5 to 7 year old females; group three are all females older than 8 years old. There was a significantly significant effect of age on daily and total milk

production (P ⩽ 0.05), with Group One being more productive (P ⩽ 0.05) than Group Two and Group Three being more productive than Group One, and Group Three producing the most total and average daily milk. It also illustrates statistical evidence suggesting that age affects milk ranges related to some milk components. Groups One and Two produced more than Group Three for age-related amounts of fat and/or lactose; Group Three produced the highest average fat and average fat percentage in the lactose and/or total milk category, whereas Group One produced the lowest average fat and/or total fat category, and Group One produced the highest total fat and/or average fat category in the group versus Group Three had the lowest total fat and/or average fat. When looking at the difference in average percentage of protein and non-fat solid between all three herds, the results indicate no significant difference between the three herds for both protein and non-fat solid. However, the age of the cow impacted significantly the RBC count – the FIFO were significantly greater (P ⩽ 0.05) as compared to the LIFO cows; there was no significant difference (P ⩽ 0.05) between the FIFO and F(children) group, while the average value of RBC count for FIFO were the highest and LIFO the lowest. Again, regarding hemoglobin concentration, the FIFO were significantly greater than the LIFO (P ⩽ 0.05); however, no significant difference (P ⩽ 0.05) existed between FIFO and F(children) herds. The average value of hemoglobin concentration for FIFO was the highest and LIFO the lowest. When examining PVBC, FIFO attributed significantly greater quantities than did the LIFO (P ⩽ 0.05). There were no significant differences (p⩽0.05) between the two groups, or between the two groups, or between the first group and the second group. The highest average count was in Group 2 and Group 3 had the lowest average count out of all separate groups. When comparing the platelet count from Group 3 to Group 1 & 2, Group3 had a significantly higher average platelet count. In addition to this, Group 2 had a significantly higher average platelet count than Group 1 (p⩽ 0.05). Group 3 had the highest average of the three groups while Group 1 had the lowest. When comparing total white blood cell counts from groups 1 (1) and (2, Group2 had a significantly higher average total white blood cell count. There were no significant differences (P⩽0.05) between the two groups. Group 2 had an average of high average compared with the average of all groups 3 had an average of low average count of total white blood cell count then Group 1. No statistically

significant difference was found between the three dairy cow groups regarding percent of neutrophils, eosinophils, lymphocytes and monocytes ($P \leqslant 0.05$). However, there were statistically significant differences between groups of cows for percent of basophils in that group two was greater than both group one and group three ($P \leqslant 0.05$) and the first group was greater than the third group. Basophils were most numerous in group 2 and least numerous in group 3..

Keywords: Age, Milk Production and Components, Blood Parameters.

Introduction

Cattle are an essential component of agriculture, making them a national and economic resource throughout the world, including Iraq, where the production of cattle yields ongoing sustainable employment for many families and individuals. There are currently over 700 different types of cattle. However, due to advancements made in breeding and genetics and the increased awareness of breeders regarding their particular breeds, many local breeds are now declining in number, and, because of the crossbreeding of cattle, currently, there are roughly 380 distinct breeds of cattle [1]. There is a relationship between the external factors and the total milk production, such as heat stress and (environmental conditions such as season) or humid conditions; or internal factors and the complete milk production, such as age, number of calves, stage of lactation, udder health, and metabolic rate (lot of things will affect a cow's or heifer's ability to produce milk) [2,3]. Also, there is an increase in milk production with age due to the increased hormonal status of a lactating cow resulting from greater amounts of metabolic activity, number of secretory cells, and number of nutrients from feed consumed [4,5]. Milk yield continues to increase on average by the cow until all the cow's physical maturity is achieved and begins to decline gradually before the cow dies [6, 7]. A cow's average milk yield at 2.5 years old (the age of first breeding) is approximately 76% of an average adult cow's milk yield. A

cow's average milk yield at 5-6 years of age is approximately 92% of that of an average adult cow. Most dairy cattle reach maturity between 6 and 7 years of age[8], and age of maturity for dairy breeds does vary somewhat. The gradual decline of milk production generally starts around 8-9 years of age. The fat content of milk is at its maximum at the 3rd lactation period, after which the milk's fat content begins to decline. The protein content of the milk will continue to decline as the cow grows older. The percentage of non-fat solids also declines. During the first lactation, there are high levels of blood glucose; as lactation periods increase, the cow's blood glucose levels decrease; as the cow ages, the cow's blood glucose levels also decrease. All age groups had similar levels of lactose [8]. Cattle physiological, hematological, and chemical components are used to indicate cattle health, metabolic function, and their potential for long term survival. Hematological components, including red and white blood cell counts and hemoglobin levels, can indicate immune function and O2 transport capabilities as well as a cattle's physiological responses to different stressors, health condition, productivity, and welfare. Measurement of hematological parameters is useful to evaluate and assess the physiological variables of individual animals that would help to establish both the animal's overall health condition and well-being through animal stress reaction, veterinarian assistance needed, and/or general productivity of that animal, amongst others. There are many factors which influence the hematological parameters of the individual animal, including age, sex,/alcohol stress, diet type, body condition, reproductive status, and level of exercise performed. Blood parameters also significantly impact milk production in dairy cattle. Red blood cells, white blood cells, hemoglobin, platelet counts, red blood cell indices and erythrocyte sizes can be measured and are used primarily for determining the health status of bovines. Changes to the hematological parameters occur with age. There is a relationship between Age and several hematological parameters including decreased biological values (Erythrocyte and Leucocyte Count, Hemoglobin Concentration, and Percentage Packed Cell Volume) and increased Platelet Count [16]. The objective of the study was to analyze the impact of age on milk production and milk composition

as well as on some hematologic parameters in bred Friesian Cows raised in Southern Iraq..

Materials and Methods

Conducted in Iraq, Thi Qar Governorate, Al-Shatra District; Al-Awad Village, from 1/10/2023 until 1/06/2024; the purpose of this research was to determine whether the age of cows affects both their daily and total milk yield, and how their respective ages affect some hematological parameters (red blood cell count, hemoglobin level, packed cell volume, platelet count, and total white blood cell count). Thirty cattle were used in the study consisting of hybrid Friesian/Al-Awad cows and being of different ages and lactation periods. The thirty exhibited cattle were assigned to three age groups of 10 head each: Two to four years, five to seven years, and eight years and continuing.

Feeding - The cows were given a mixture of concentrate feed, roughage, and green food based on what was available during that particular time of year; dry roughage and green food were both provided based upon the animal's body weight, while concentrated feeds (based upon the amount of milk produced) were given at one liter of concentrate feed per two kilograms of milk produced. All of the cows were in good physical condition.

To estimate the amount of milk produced by each cow, we weighed the udder once it was empty using a Chinese electronic dairy scale. The cows were milked by hand two times daily - once in the morning and again in the evening. For each cow, 100 mL raw milk samples were collected and stored in a cooler with crushed ice for preservation. Samples were analyzed for their components at the laboratory using a German Lacto Flash Funke Gerber analyzer. The milk was sampled every two weeks (twice a month).

Collection of Samples by Drawing: Blood was obtained via venipuncture (from the jugular vein) with a sterile syringe (10 ml). The 2-ml aliquot collected in an anticoagulant (EDTA) tube was transported for hematologic analysis in a cooled container (ice) to avoid hemolysis; blood was analyzed based upon a general laboratory protocol.

Measurement and Assessment of Hematological Parameters: RBC (Total Red Blood Cell Count), Hb, PCV (Packed Cell Volume), WBC

(Total White Blood Cell Count), and Differential White Blood Cell Count using a Mindor 2800 Hematology Analyzer (Germany) as per the manufacturers Guidelines.

Statistical Analysis:The data were statistically analyzed using the [17] software, and the significance of the means was tested using LSD.

Results and Discussion

Table (1) illustrates a highly significant age effect (P<.05) on daily and overall production. The second group (cows aged 5-7 years) outperformed the first (cows aged 2-4 years) and the third group (cows aged 8 years and older), while the third group outperformed the first group. The means by age group were (0.5 +/- 8.58 kg, 1.74 +/- 13.26 kg, 0.88 +/- 10.64 kg), (105.0 +/- 1801.8 kg, 365.4 +/- 2784.6 kg, 184.8 +/- 2234.4 kg), respectively. The findings of the present study are in accordance with previously reported data [18;19;20;21;22]. This relationship is explained by the fact that the ageing process incorporates a complete maturation of bodily systems (i.e., the udder) as well as an increase in the size of the digestive system allowing the animal to consumemore feed to satisfy the increased production level that accompanies its age. After a period of increasing production,age-related declines in production begin to occur as a result of the age-related deterioration of the cow's teeth..

Table (1) : Effect of cow age on daily and total milk production(Mean ±SE).

Age(Year)	Daily milk(kg)	Total milk production(kg)
2-4	c 8.58±0.5	105±1801.8c
5-7	a 13.26±1.74	365.4±2784.6 a
8 and older	b 10.64±0.88	184.8±2234.4b

Different letters within the same column indicate significant differences in probability (P<0.05)

Table 2 shows that age has a very significant effect (p<0.05) on some components of milk. Group 1 and Group 2 cows produced significantly

more ($p<0.05$) fat and lactose than did Group 3 cows, respectively. There was no significant difference ($p<0.05$) between Groups 1 and 2 for either fat or lactose. The average fat and lactose percentages for Group 1 were greater than Group 2, which were greater than Group 3 (see Table 2). There were no significant differences ($p<0.05$) between Groups 1-3 with regard to either protein or non-fat solids percentages. The increases in percentages of protein and lactose for Groups 1 and 2 were not statistically significant. These results are consistent with those of 23, 24, 25, 21, 26, and 22 who reported that milk components were higher in younger animals than in older animals, as well as the inverse relationship between milk yield and its components..

Table (2: Effect of cow age on daily and total milk production (Mean ±SE).

Age (year)	fat%	Protein %	Lactose%	Non-fat solids%
2-4(1)	a0.26±3.83	a 3.36±0.23	0.18±4.79a	0.99±8.96a
5-7(2)	0.15±4.65a	a 3.20 ±0.20	0.23±3.71a	0.37±8.72a
8 and older(3)	0.20±3.20b	a 2.99±0.22	0.14± 4.22 b	0.31± 8.24 a

Different letters within the same column indicate significant differences in probability (P<0.05)

According to Table 3, age appeared to significantly affect some hematopoietic parameters ($P < 0.05$). The red blood cell counts of the first and second groups of cows were statistically greater than that of the third group [$P <0.05$]. There were no significant differences in red blood cell counts between the first and second groups of cows. However, within these three groups, the second group had the highest mean red blood cell counts, and the third group had the lowest mean red blood cell counts. These means for red blood cell count were (56 ± 7.56), (0.13 ± 7.70), and (0.09 ± 7.25) × μg/μL, respectively. These results were comparable to the data reported by [16, 27, 28, 9]. In addition, [29] reported that as a cow ages, the glomerular filtration rate (GFR) decreases, resulting in chronic kidney disease and poor production of erythropoietin (i.e., the hormone responsible for producing red blood cells) and therefore lower red blood

cell counts. As shown by Table 3, age is also associated with a statistically significant change in hemoglobin concentrations ($P < 0.05$). Hemoglobin concentration was significantly lower in Group 3 when comparing Groups 1 and 2 to Group 3 ($P<0.05$), but there was no significant difference between Groups 1 & 2 ($P<0.05$). The highest hemoglobin concentration (mean) was found in Group 2, and the lowest concentration in Group 3. Mean hemoglobin concentrations for Groups 1, 2, and 3 were approximately 0.56 ± 11.44 g/100 ml, 0.42 ± 11.88 g/100 ml, and 0.17 ± 10.49 g/100 ml, respectively. With regard to packed cell volume (BCV), Group 2 had significantly higher BCV than Group 3 ($P<0.05$), and there were no significant differences between Groups 2 & 1 ($P<0.05$) and Groups 3 & 1 ($P<0.05$). The highest BCV was found in Group 2, while the lowest BCV was recorded in Group 3. Group means for Group 1, Group 2, and Group 3 were 1.75 ± 36.02, 1.28 ± 38.43, and 0.49 ± 32.89, respectively. Results obtained from this study are consistent with [16,28,30]. The reduction of red blood cell numbers, hemoglobin concentrations, and packed cell volumes with the increase in age may be caused by red blood cells being especially vulnerable to the impact of free radicals, which also increase with age because they are primarily responsible for transporting oxygen and do not have the capacity to regenerate; in addition, the membranes of red blood cells contain peroxide [31]. Free radicals that develop as a result of oxidative stress decrease hemoglobin concentrations due to the injury to cells from free radicals, which subsequently generates chromosomes, which are then converted into a family of pigments known as hemichromates, while at the same time there is continued production of superoxide free radicals [32]. Data revealed that there was a significant effect ($P<0.05$) of age on platelet count outcomes. The only significant difference in mean platelet counts for the cow groups were between group two and group one ($P<0.05$) and group three and group two ($P<0.05$). Group three had the highest mean platelet count and group one had the lowest mean platelet count. The group means were 11.61 + 221.14, 27.41 + 325.67, and 50.14 + 532 × µL, respectively. These findings match [16,28].

Table 3 : Effect of age on total red blood cell count, hemoglobin, packed cell volume, and platelet count (Mean ±SE).

Age(Year)	RBC	Hemoglobin	PCV	Platelet count
2-4	0.10± 7.56 a	ab 11.44±0.56	1.75±30.02ab	11.61±221.14c
5-7	0.13±7.70 a	a 11.88 ±0.42	1.28±38.43a	27.41±325.67b
8and older	0.09±7.25 b	b10.49±0.49	0.49±32.89b	50.14±532a

Different letters within the same column indicate significant differences in probability (P<0.05)

As demonstrated in Table (4), age plays a significant role (P<0.05) in the total number of white blood cells present in a sample. The first two groups of female animals had a much higher total number of white blood cells (P<0.05) compared to group 3. Furthermore, there were no significant differences between groups 1 and 2 at this level. However, group 2 exhibited the highest mean total number of white blood cells, while group 1 contained the lowest mean value. The mean values for groups 1, 2, and 3 were 0.19 ± 7.80, 0.20 ± 7.98, and 0.09 ± 7.27, respectively. These findings are similar to that of [33, 34]. Many researchers believe that the decrease in total number of white blood cells may occur with increased age as the cell membranes of white blood cells contain a high composition of phospholipids/cholesterol. The older we get, the more free radicals will accumulate on these components that make up our cell membranes and this will eventually have substantially impacted on the structural integrity and quality of our cell membranes leading to a loss of cells; therefore, a decrease in their number due to free radical accumulation over time will ultimately lead to the reduction or death of those cells in your body. The oldest adult may also experience 'aging' related problems and illnesses associated with the (1) Dysfunctional Immune System or (2) age-related illness with continued or overuse of prescription drugs and vaccinations over their lifetime, causing long-term adverse effects on your body and decreasing your body's ability to respond to infections and subsequently a decrease in the total

number of white blood cells [35,36]. In addition, the current data is also consistent with data reported [16, 28, 37, 9]. There was no significant ($P<0.05$) difference between the mean percentages of neutrophils, eosinophils, monocytes and lymphocytes by age from any of the groups of cows (3 age classifications) but it appears that cows in the first and second groups had a significantly higher percentage (%) of basophils compared to cows from groups 3 and 4 and 5. There was no difference that was statistically significant between the first and the second group of cows. The second group produced the greatest percentage of basophils. The group that produced the lowest percentage of basophils was the third group of cows..

Table (4): Effect of Age on Total White Blood Cell Count and Differential White Blood Cell Count (Mean ±SE).

Age(Year)	WBC	Eosinophils %	Lymphocytes%	Neutrophils %	Monocytes	Basophil %s
2-4	0.19±7.80a	a 3.92±1.052	a39.45±6.19	±5.24 a30.60	1.39± 2.25a	0.01±1.044b
5-7	0.20±7.98a	a 4.36±1.24	a34.04±4.74	32.73 ±5.52 a	0.91± 2.84a	0.01±1.20a
8 and older	2.37 ±1.15 a	1.34±5.94a	a 33.9 ±5.04	42.28 ±7.42 a	0.09±7.27 b	0.005±0.79c

Different letters within the same column indicate significant differences in probability (P<0.05)

Conclusions: This research indicates that a cow's age is a key factor influencing its production of milk and the components thereof. Each

individual cow has a peak production time as it reaches appropriate age; at that time, cows will start to see a gradual decline in their ability to produce milk as they become older, and as they lose their teeth. Compared to a mature cow's milk, a younger cow's milk has a larger amount of all milk components, but older cows will have less of all the components of their individual cow's respective milk. There are many other hematological parameters that also demonstrate the effects of age. The higher the number of red and white blood cells, hemoglobin levels, and packed cell volume noted in a mature to middle aged cow. In contrast, when you look at middle age cows; they were noted to have a peak platelet count (the number of platelets in blood) and then subsequently begin to decline with advanced age..

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