بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Graduate Studies

The Effect of Season on Hematological Blood Parameters and Milk Production in Local Breed (kenana) and Cross Breed (kenana * Holstein Friesian) in Sudan

تأثير الموسم علي مكونات الدم و انتاج اللبن في سلالة كنانة والسلالة الهجين (كنانة * هولشتاين فريزيان) في السودان

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قال تعالى:

(وَإِنَّ لَكُمْ فِي الْأَنْعَامِ لَعِبْرَةً نُسْقِيكُمْ مِمَّا فِي بُطُونِهِ مِنْ بَيْنِ فَرْثٍ وَدَمٍ لَبَنًا خَالِصًا سَائِغًا لِلشَّارِبِينَ)

صدق الله العظيم

سورة النحل – الآية 66

DEDICTION

To my family

To my mother and father

To my large family, especially my second mother Raja

and my brothers Mohammed Mustafa, Youssef, Alaeddin and

Abdel Moneim

Thank you very much for standing on my side in the most difficult times and encouraging me.....

I love you

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List of acronyms

RBC	Red Blood Cell
WBC	White Blood Cell
HGB	Hemoglobin Concentration
HCT	Hematocrit
MCV	Mean Corpuscular Volume
MCH	Mean Cell Hemoglobin
PLT	Blood Platelets
LYM	Lymphocytes Percentage
MID%	Mid Cells Percentage
GRAN%	Granulocytes Percentage
LYM	Lymphocytes Total Count
MID	Mid Cells Total Count
GRAN	Granulocytes Total Count
HCT%	Hematocrit Percentage
MCH	Mean Cell Hemoglobin
MCHC	Mean Cell Hemoglobin Concentration
RDW-CV%	Red Blood Cell Distribution Width- Cell Volume Percentage
RDW-SD	Red Blood Cell Distribution Width -Size Distribution
MPV	Mean Platelet Volume
RDW	Red Cell Distribution Width

Abstract

This study was carried out to determine the reference values of Kenana breed and cross breed (Friesian x Kenana) under the Sudan climate, and also to evaluate the effect of seasonal changes and local climatic conditions on the Kenana blood and cross breed and their milk production.

The experiment conducted in two research centers farms, namely the Animal Production Research Center (Kuku in Khartoum), representing the (Friesian x kenana) hybrid, and Animal Production Research Center (Um Beninin Singa).

Twenty dairy cows (10 Kenana and 10 crossbred) were used in this experiment. The samples of blood were collected during two seasons (summer and winter). The blood parameters measured RDK-SD, RDW, RDK, RDM, GRT, GRM, HN, MPG, GRAN, LYM, MPG, GRAN and they were analyzed by Automated Hematology Analyzer.

Statistical analysis showed that in summer season there were no significant difference between the two groups in all parameters except (RBC), (HGB) and (HCT) as they were high in Kenana breed. On the other side in winter season just (MID%), (MID#) and (RDW-CV) showed a significant increase ($p \leq 0.05$) between Kenana and the Cross breed, compared to the Red Blood Cell (RBC), (HGB) and (HCT) which showed a high significant increase ($p \leq 0.01$) between Kenana and the cross breeds in winter season and all were in favour of Kenana breed except RDW-CV which was in favour of the cross breed.

For milk production there were significant differences ($p \leq 0.05$) between the two breeds in milk yield, daily milk and Lactation Length, all in favour of the crossbred.

The lack of differences in the environmental variables among the two breeds suggests that the differences found in hematological parameters studied in the two groups were attributable exclusively to the different cattle breed and seasons and adaptive mechanism in response to heat stress. The cross breed proved to be highly adaptable to harsh climatic conditions and resistant to common diseases prevalent in Sudan.

ملخص البحث

أجريت هذه الدراسة لتحديد قيم مرجعية دموية لسلالات الكنانة (المحلية) والسلالات الهجين (Friesian x kenana) تحت مناخ السودان ، وأيضاً لتقييم تأثير التغيرات الموسمية و الظروف المناخية المحلية على مكونات الدم في كنانة والسلالة الهجين وإنتاج الحليب. اجريت التجربة في مركزين للبحوث بمزرعتي مركز أبحاث الإنتاج الحيواني (كوكو في الخرطوم) الذي يمثل الهجين (Friesian x kenana)، ومركز بحوث الإنتاج الحيواني (Um Beninin Singa) الذي يمثل السلالة المحلية (Kenana).

تم استخدام عشرين بقرة حلوب (10 كنانة و 10 هجين). جمعت عينات الدم خلال موسمين (الصيف والشتاء). تم تحليل عينات الدم لـ RDK-SD و RDW و RDK و RDM و GRT و GRM و HN و MPG و GRAN و LYM و MPG و GRAN. تم تحليل جميع القياسات باستخدام جهاز تحليل الدم (Automated Hematology Analyzer).

أظهر التحليل الإحصائي أنه في فصل الصيف لم يكن هنالك فرق كبير بين المجموعتين في جميع القياسات باستثناء بعض القياسات (HCT) (HGB) (RBC) التي كانت عالية في سلالة Kenana. من الجانب الآخر فقد اظهر فصل الشتاء زيادة معنوية ($P\leq 0.05$) بين السلالتين في (MID ٪) ، (MID #), (RDW-CV) ، مقارنة مع (RBC), (HGB) و (HCT) والتي أظهرت فرق معنوي عالي ($P\leq 0.01$) مقارنة بين السلالة المحلية كنانه و الهجين و كانت جميعها لصالح سلالة كنانة باستثناء (RDW-CV) والتي كانت لصالح الهجين .

أما بالنسبة لإنتاج الحليب ،فقد كانت هناك اختلافات معنوية ($p\leq 0.05$) بين السلالتين في إنتاج اللبن والحليب اليومي وطول الموسم ، وكلها لصالح الهجين.

ويشير عدم وجود اختلافات في التغيرات البيئية بين السلالتين إلى أن الاختلافات الموجودة في القياسات الدموية تحت الدراسة في المجموعتين تُعزى إلى إختلافات السلالات والمواسم وآلية التكيف استجابةً للإجهاد الحراري. ثبت أن السلالة الهجين قابلة للتكيف بدرجة عالية مع الظروف المناخية القاسية ومقاومة للأمراض الشائعة في السودان.

CHAPTER ONE

INTRODUCTION

Sudan is the largest African country, occupying an area estimated at (1,882,000) km^2 (Qaarb 2018), with great variation in climatic conditions. Marked seasonal changes are encountered in temperature, rainfall, relative humidity and wind velocity. The country is also endowed with diverse agricultural environment which is determined by climate and animal resources and human population density (AOAD, 1984)

Indigenous breeds of zebu cattle (Bosindicus) in the tropical regions have been known for their low inheritance productivity; they are well adapted to the local environmental conditions. They have high tolerance to heat stress and are able to survive long periods of feed and water shortage (El-Amin and Osman, 1971).

Among the cattle population in Sudan, Kenana and Butana are promising indigenous milk breeds, which under improved feeding and management yield more than 1500 kg milk per lactation (Saeed et al., 1987, El-Habeeb, 1991; Musa et al., 2005). Kenana cattle homeland is located at a triangular area bounded by Sinner, Singa, Roseiries and Kosti, (AOAD, 1984).

Recently, the demand for liquid milk has increased with the rise in human population; therefore improvement of dairy cattle has become of paramount importance. Attempts to introduce exotic breeds into the Sudanese local breeds have resulted in relative improvements of the overall average productivity (Musa et al., 2005). Early attempts for improvement of dairy cattle in Sudan started by grading-up of local breeds, by introduction of foreign blood in the herd of the Army Veterinary Department in 1907.

Indigenous breeds of cattle in the tropics and subtropics have been known for their low inheritance productivity; however in most cases they have been selected for their advantage of adaptation to extreme adverse environmental conditions. Attempts to introduce exotic blood into the Sudanese local breeds have resulted in relative improvements of the overall average productivity (Hewett, 1974).

Seasonal and environmental changes may influence hematological values in domestic animals (Feldman *etal*., 2002). Thermal environment is major factors that can negatively affect cow performance, especially in animals of high genetic value. Increased livestock productivity may lend with increased susceptibility diseases that reflect changes in blood profile (Hewett, 1974). The variation in environmental variables such as ambient temperature, relative humidity, wind and rainfall were recognizedas the potential hazards in livestock growth and production. Some specieshave evolved endogenous annual rhythmicity as an adaptive mechanism to react in advance to regular environmental changes associated with the seasons (Piccione *etal*., 2009). Since merger very less research has been done on the hematology on local and cross-bred cows in Sudan.

The Specific Objective at This Study to :

- Establish hematological reference values of Kenana and cross breeds (K*F) under Sudan climate.
- Assess the effect of seasonal variations under local climatic conditions on blood profile, and milk production of kenana and cross breed.

CHAPTER TWO

LITERATURE REVIEW

2-1: Types of tropical cattle:

Domesticated cattle are usually classified in to two major group: zebu (Bosindicus) and European (Bostourus), these groups are considered to constitute in to two different species (Epstein, 1971 and Mason, 1984).

2-1-1 Cattle Breeds

Sudanese cattle belong to the species *Bosindicus* which includes humped cattle (Zebu) of Asia and Africa. Sudanese cattle are broadly classified into two breeds: Nilotic cattle and North Sudan Zebu cattle (Joshi *et al*., 1951). Nilotic cattle have long horns and small hump and originated from interbreeding between Hamitic longhorn and the Indian Zebu. Northern Sudan Zebu cattle vary in size depending on environmental conditions but are larger than Nilotic cattle. Sudanese cattle are distributed as follows:

1. Kenana cattle are found along the banks of the Blue Nile. Coat colour is white to grey and tends to get darker at the head and feet. The udder is slightly yellowish in colour; and the distinctive white grey skin colour is stronger in males than females. Mature Kenana bulls and cows may weigh over 500 kg and around 400 kg, respectively.
2. Butana cattle are found between Blue Nile and River Attbarah. They are red in colour and slightly dark red at the extremities. Butana cattle are one of the heaviest Sudanese cattle breeds and are kept for milk production.
3. White Nile cattle are found along the banks of the White Nile. They are mixtures of Western Sudan Baggara cattle and Kenana cattle. White Nile cattle display many colours.
4. Western Sudan Baggara cattle are found in Western Sudan in Kordofan and Darfur regions. Baggara cattle display variable coat colours and are given different names in different areas.

5. Nuba cattle (Koalib) are found in western Nuba Mountains. They are small and tolerant to trypansomiasis. Coat colour is black but other colours may exist.

6. Baladi cattle are nondescript and are widely distributed in different parts of Northern Sudan.

7. The cattle of Southern Sudan are predominately Nilotic cattle. Several tribal types may be identified e.g., Murle cattle, Taposacattle, Mongalla cattle, Anwak cattle and Nilotic Sanga cattle (Mason and Maule, 1960).

2-1-1: Sudan zebu cattle breed:

Sudan is the largest country in Africa. It has 40.3million cattle, 49.8million sheep, 42.1million goat and 3.5million camels. Sudan cattle refer to zebu cattle, they were broadly classified in to three types: Arab or Northern Sudan short horned zebu cattle, Nilotic cattle and Nuba mountains cattle breed (Bennet et .al,1954).

Sudan possesses large population of cattle in Africa. Sudanese cattle are broadly classified into two breeds: Nilotic cattle and North Sudan Zebu cattle. Types that are related to North Sudan Zebu cattle include: Kenana, Butana (Rofaah), White Nile, Western Sudan Baggara, Foja (Dar Al-Reehcattle), Qash cattle (Baraka cattle), Arashie cattle, Red Um Bororo, Ingessana cattle and Sudanese Fulani. Kenana and Butana possess good potential for milk production in comparison with the other ecotypes of North Sudan Zebu and Nilotic cattle breed. Mean lactation milk yield of Kenana cows is 1836±186 litre in mean lactation length of 308±6 days. The maximum yield of Butana cows in 330 days was 3012 litre. Nilotic cattle are very poor milkers probably for genetic reasons. Judged by international standards milk production potential of most indigenous Sudanese cattle is sub-optimal(Abdel Rahman ,2007).

2-2: Northern Sudan short horned zebu cattle:

This type is mainly found in Northern Central Sudan herded by the nomadic tribes between 10^{th} and 14^{th} parallels of latitude (Khlalil,1961). The

Arab cattle breed in the Sudan included three types: Kenana, Butana and Western baggara. The Kenana and Butana cattle are the two indigenous dairy breeds in the Sudan.

2-2-1: Kenana cattle in Sudan:

This estimated to be about 3million heads and this population include type known locally as white Nile type. They are found largely in traditional area which is adjacent to the white and blue Nile rivers, in an area stretching South from Khartoum to the Ethiopiam boarder (Cunningham, 1987).

This ecological zone is typically allow rainfall savannah area with high temperature and low humidity, these animal are being kept by sedentary agro-pastoralists as the expense of the nomadic breeders (Cunningham 1987).Kenana are subtype of Northern Sudan zebu (Roman et al, 1981),resulting from the crossing between the short horned Zebu and the Sanga cattle during the early migration in the ancient time (Roth,1998). Kenana classified in to two types: are Northern kenana cattle (Fung cattle)and Southern kenana cattle (Kosti cattle) (Abu-Alazim,1993). They are the largest Africa zebu and have several strains namely Ruffiai Elhoi, Ruffai Elsharik, Gezira and White Nile (Cunningham 1987).

2-2-1-1: Physical characteristics:

Kenana cows are medium to large in size, the coat colours is light blue-grey with gradation from nearly white to steel grey, shading to nearly black on head, horns, tail , hind quarter, legs and neck hump.

(muzzle-horns-tail lip and hooves) are black (Figure 1 and 2) (Saeed et .al,1987).The calves are usually born red or white but colours are gradually change at 3 to 6 months of age (Payne,1970). Mature animals have large hump, Pendulous dewlap and short horns as described by (Osman,1983).The average adult live weight for males and females are 500-625kg and 400-500kg respectively (Abu-Alazim,1993) and the average high at withers for males and females are 132-148cm and 124-138cm respectively (Rege 1999).

2-2-1-2: Productive characteristics:

Kenana cows are used for milk production. The milk yield per lactation ranging from 1200 to 4500kg, in an average lactation period of 240 days (Dunn et al, 1969). At birth male calf weight 22-25kg.Daily weight gain from birth to weaning is 0.37kg for male and 0.44kg from female (Saeed et al,1987).The feed conversion ratio is 5.8kg feed/kg gain (Guma, 1996).

2-2-1-3: Milk yield:

Milk yield per lactation ranging from 1200 to 4500kg in an average lactation period of 240 days (Dunn et al, 1969). Several investigations have been determined milk yield in some Sudan cattle breed. In Northern Sudan Zebu cattle average milk production was 2272.7kg (Mclaughlin,1955), Kenana and Butana ranged between (2136 ± 106.6 and 1662.57 ± 108.9) to (1407 ± 695kg) respectively (Abdalla et. al, 1990 ; Mohammed et. al, 1991 ; Musa, 2001 ; Ageeb and Hillers ,1991). (Douglas, G.H and Ginther, 1973) reported from Ombenen livestock center that there were few Kenana cows yield up to 50 Ib of milk per day. In Kenana milk yield found to be 2136±16kg (Abdalla et. al,1990; Mohammed et. al,1991). Northern Sudan Zebu cattle milk yield was 2272.7kg (Mclaughlin, 1955). Osman and Elamin,(1971) estimated 2088kg in 305 days milk yield in Northern Sudan zebu cattle. Osman, (1972) reported a production of 3.58 liter/day for Sudanese indigenous cows at GawazatStation.

Several investigations estimated the lactation period in some Sudanese cattle breed. In Northern Sudan Zebu cattle, Kenana and Butana lactation length were 272.05±4.28, 198±2.4, 268.17±**days respectively.(Osman, 1972; Saeed et. al, 1987; Musa,2001). Morever lactation length of Kenana cattle in Wad Madni was 224±85days(Alim,1960).Osman,(1972) stated that mean lactation length of Sudanese cattle at Gazala Gawazat was 272days.

2-3: Crossbreed in Sudan:

Crossbreed is good method for producing changes in characteristics of animal population (Armstrong et al,1988). In Sudan the first attempt at

crossbreeding was performed in Belgravia farm (Khartoum north) in 1925 by using shorthorn bulls imported from England mated with native cattle (Butane).Then, in Sudan used crossing were used in 1971 by introduction of Friesian bulls for the American mission in Khartoum, the breed of this bulls were shorthorn, Guernsey and Friesian. Friesian crossbreed were found to perform better than other exotic crossbreed because of the cast adaptation to environment and high yield capacity. Most crossing operation in Sudan used Kenana and Butane indigenous breed with exotic ones (Medani, 1996).

Milk yield for crossbreed (Frisian x Kenana or Butane) having 50%,62.5% and 75% Friesian blood were 4306,5733 and 3146 Ib respectively Yousif et al,(1998) explained that milk yield of crossbred cows was significantly influenced by percentage of foreign blood. Sid Ahmed, (1986) obtained mean milk yield of crossbreed cows 514.66 ± 9.30 imperial gallon. Abdel Mageed, (1988) reported that the highest average daily production was reached in the fourth lactation season on graded cattle 15.5 ± 2.4kg/cow/day while in local cattle it was 7.6 ± 2.2kg/cow/day. Danasoury, and Bayoumi,(1962) stated that crosses of 50% friesian at Nisheishiba gave 1775kg, while 25,37.5, 50 and 75% foreign blood at Belgravia gave 2292,2324,2347 and 2456kg per lactation respectively, Hassan,(1988) reported that foreign blood percentage affected milk yield, the overall monthly yield was significantly higher in the cows with 50% or more foreign blood compared with the lower foreign blood percentage.(Hassan ,1988) stated that with more than 50% foreign blood yielded daily average of 25.7 Ib/day while those with less than 50% foreign blood yielded average of 20.3Ib/day, Ibrahim,1989 found the highest average production in cows with 62.5% foreign blood, when compared with cows of 25,37.5,50 and 75%.

2-4 Effect of season on milk production:

Heat stress did not change the level of milk production throughout whole lactation in our environment, and lactation curve did not show more important deviations. Increased value of THI showed a nonsignificant effect

on yield and quality of milk in the first third of lactation. In the middle and at the end oflactation THI was significantly negatively correlated with yield and quality of milk. The average amount of milk yield, milk fat and protein percent is statistically significantly lower in the middle and at the end of the lactation during the exposureto heat stress (Marko *et al*. 2010).

Heat stress in dairy cows is characterised by reduced milk yield and decrease of the quality of milk (Cincović and Belić, 2009). Decline in productivity occursbecause of reduced food intake, as a result of endocrine and metabolic adaptationto a high body and environmental temperature (Hristov et al., 2007; Bernabucci et al., 2010).

2-5:Blood Components

2-5-1 :Blood:

Blood is a body fluid in humans and other animals that delivers necessary substances such as nutrients and oxygen to the cells and transportsmetabolic waste products away from those same cells in vertebrates, it is composed of blood cells suspended in blood plasma. Plasma, which constitutes 55% of blood fluid, is mostly water (92% by volume), and contains proteins, glucose, mineral ions, hormones, carbon dioxide (plasma being the main medium for excretory product transportation), and blood cells themselves. Albumin is the main protein in plasma, and it functions to regulate the colloidal osmotic pressure of blood. The blood cells are mainly red blood cells (also called RBCs or Erythrocytes), white blood cells (also called WBCs or Leukocytes) and platelets (also called Thrombocytes). The most abundant cells in vertebrate blood are red blood cells. These contain hemoglobin, an iron-containing protein, which facilitates oxygen transport by reversibly binding to this respiratory gas and greatly increasing its solubility in blood. In contrast, carbon dioxide is mostly transported extracellularly as bicarbonate ion transported in plasma (*Franklin*. 2009).

The level of biochemical parameters of the blood is important in determining the health and illness status of animals and in making clinical evaluation. So it

should be understood how normal values turn into abnormal values due to many factors, such as management, feeding and illness (Utlu *et al*., 2004).

2-5-2: Complete Blood Count (CBC):

The CBC is used as a broad screening test to check for such disorders as anemia, infection, and many other diseases. The hematological studies of cattle are used as the so-called screening examination or in order to establish initial diagnosis, therefore they are often taken into account in diagnostic profiles in specialist literature one can encounter tests suggesting that red and white blood cells count as well as hemoglobin concentration do not show great seasonal differences, and do not depend on the cows' physiologic at state (Dale and Ishler,1997).CBC is actually panel of tests that examines different parts of the blood and includes the following:

1) White Blood Cell (WBC):

White blood cell (WBC) count is a count of the actual number of white blood cells per volume of blood. WBC assesses the ability of the body to respond to and eliminate infection. Eating, physical activity, and stress may alter white blood cell differential values. (MVH, 2018)

2) Lymphocytes Percentage (LYM):

Lymphocyte percent. Leukocyte that normally makes up about 25% of the total white blood cell count. (MVH,2018)

3) Mid Cells Percentage(MID%):

Mid-range percent. Basophils normally constitute 1% or less of the total white blood cell count. Eosinophils, normally about 1-3% of the total white blood cell count. Monocytes make up 5-10% of the total white blood cell count. (MVH, 2018)

4) Granulocytes Percentage (GRAN%):

Granulocyte percent. Granulocytes normally up to 60% of the total white blood cell count. (MVH, 2018)

5) Lymphocytes total count (LYM):

LYM means lymphocyte absolute count. Lymphocytes occur in two forms: B cells, which produce antibodies, and T cells, which recognize foreign substances and process them for removal. (MVH, 2018)

6) Mid Cells total count (MID):

MID means mid-range absolute count. This count generally includes monocytes, eosinophils and basophils. Monocytes functions in the ingestion of bacteria and other foreign particles. Eosinophils are believed to function in allergic responses and in resisting some infections. Basophils may increase or decrease in certain diseases. (MVH, 2018)

7) Granulocytes total count (GRAN):

GRAN means Granulocyte absolute count. Neutrophils (also known as segs,) normally the most abundant type of white blood cell. (MVH, 2018)

8) Red blood cell (RBC):

Red blood cell (RBC) count is a count of the actual number of red blood cells per volume of blood. Both increases and decreases can point to abnormal conditions (MVH, 2018). reported that the indicated a rise in PCV as the pregnancy advanced and the possible explanation for this phenomenon could be an increase in RBC volume causing an increased volume of water during advanced pregnancy (Khadjeh et al, 2002).

Erythrocytes have an average diameter of 5‑6 μm in cattle, which is small compared to other species. The key function of erythrocytes is the transport of oxygen, which is bound to hemoglobin. Erythropoiesis, which takes approximately 5 days, is stimulated by erythropoietin and occurs in the bone (**Wood et al ,2010-Brockus,2011).** Marrow parenchyma Bovine

Erythrocytes have a relatively long life span of 130‑160 days

9) Hemoglobin (HGB):

Hemoglobin measures the amount of oxygen-carrying protein in the blood (MVH, 2018).The Hb concentration was highest in the 4-5 year old group and there was adecrease in the concentration of Hb values in buffaloes above 5 year old ,This may be due to the reduction of the red the bone marrow and the decreased erythopoiesis (Feldman, *et al* 2000; Khadjeh and Papahn, 2002).

10) Hematocrit percentage (HCT%):

Hematocrit measures the percentage of red blood cells in a given volume of whole blood. (MVH.2018)

11) Mean cell volume (MCV):

The mean value essentially evaluates variation in RBC size, iron deficiency results in a decrease MCV (microcytosis) because inadequate hemoglobin concentration. The MCH is an estimation of the amount of hemoglobin in the blood per erythrocyte. Iron deficiency results in a decreased MCH. The MCHC is the most accurate of erythrocyte indices. Reticulocytosis (erythroid regeneration or iron deficiency) results in a decreased MCHC while hemolysis causes an increased MCHC (Gavan, et al 2010).The mean cell volume (MCV) is elevated when RBCs are larger than normal (macrocytic). (MVH, 2018)

12) Mean Cell hemoglobin (MCH);

Mean Cell hemoglobin (MCH) is a calculation of the average amount of oxygen-carrying hemoglobin inside a red blood cell. Macrocytic RBCs are large so tend to have a higher MCH. (MVH.2018)

13) Mean Cell hemoglobin concentration (MCHC):

Mean Cell hemoglobin concentration (MCHC) is a calculation of the average concentration of hemoglobin inside a red cell. (MVH, 2018)

14) Red blood cell distribution width-cell volume percentage (RDW-CV%):-

Red cell distribution width (RDW) is a parameter that measures variation in red blood cell volume percentage (MVH, 2018)

15)Red blood cell distribution width -size distribution(RDW-SD):-

Red cell distribution width (RDW) is a parameter that measures variation in red blood cell size distribution (MVH, 2018)

16) Platelet (PLT):

The platelet count is the number of platelets in a given volume of blood. Both increases and decreases can point to abnormal conditions of excess bleeding or clotting. (MVH, 2018)

17) Mean platelet volume (MPV):

Is a machine-calculated measurement of the average size of platelets found in blood and is typically included in blood tests as part of the CBC. Since the average platelet size is larger when the body is producing increased numbers of platelets, the MPV test results can be used to make inferences about platelet production in bone marrow or platelet destruction problems. (AACC, 2018)

18) Red cell distribution width (RDW):

Red cell distribution width (RDW) is a parameter that measures variation in red blood cell size or red blood cell volume. RDW is elevated in accordance with variation in red cell size (anisocytosis), when elevated RDW is reported on complete blood count; marked anisocytosis (increased variation in red cell size) is expected on peripheral blood smear review (AACC, 2018)

Hematological reference ranges is generated from a group of healthy animals with environmental and physiological characteristics as similar to the patient as possible. The total number of RBCs is , hematocrit (HCT), hemoglobin (HGB), erythrocyte indices, and occasionally the red cell distribution width (RDW). Erythrocyte indices include mean corpuscular volume (MCV), mean

corpuscular hemoglobin (MCH), andmean corpuscular hemoglobin concentration (MCHC).

Reference intervals for bovine hematologic parameters from 3 sources are summarized in (Table2.1).

Table 2.1 Bovine hematology reference intervals according to 3 so

Parameter	Unit	Wood and Quiroz-Rocha (2010)50	Kraft and Durr (2005)27	George et al. (2010)16
Erythrocytes	106/µl	4.9–7.5	5–10	5.1–7.6
Hematocrit	%	21–30	28–38	22–33
Hemoglobin	g/dl	8.4–12.0	9–14	8.5–12.2
Mean corpuscular volume	Fl	36–50	46–65	38–50
Mean corpuscular hemoglobin	Pg	14–19	11–17	14–18
Mean corpuscular hemoglobin concentration	g/dl	38–43	31–34	36–39
Red cell distribution width	%	16–20	NA	15.5–19.7
Reticulocytes	103/µl	0	NA	NA
Leukocytes	103/µl	5.1–13.3	5–10	4.9–12.0
Platelets	103/µl	160–650	300–800	193–637
Mean platelet volume	Fl	4.6–7.4	NA	4.5–7.5

(Leonie et al **2014)**

2-6 :Effect of blood on milk production:

Hematological parameters reflect the adaptability of cows to adverse environmental conditions, as well as other stressors. Hematological and biochemical profile within normal physiological limits reflects a good health status and is highly correlated with milk production (Coroian et al., 2011). Blood parameters analysis can identify if there are errors in nutrition in lactating cows (Payne et al., 1970).

2-7: The blood:

All of the cells in the peripheral blood have finite life spans and thus must be renewed continuously. The mechanisms responsible for regulating steady-state hematopoiesis and the capacity to modulate blood cell production in response to stresses such as anemia or infection consist of a series of progenitor cells in the bone marrow and a complex array of regulatory factors (Gamal,2014).

It is the process of blood cell production, differentiation, and development. The hematopoietic system consists of the bone marrow, liver, spleen, lymph nodes, and thymus (Gamal,2014).

It starts as early as the 3rd week of gestation in the yolk sac. By the 2nd month, hematopoiesis is established in the liver and continuous through the 2nd trimester (Gamal, 2014). During the 3rd trimester it shifts gradually to bone marrow cavities. During infancy: all marrow cavities are active in erythropoiesis "Red Marrow". During childhood: erythropoiesis becomes gradually restricted to flat bones as; skull, vertebrae, sternum, Ribs and pelvic bones, in addition to ends of long bones. The shafts of long bones become populated by fat "yellow marrow"(Gamal, 2014).

2 -8: Blood Cell Development:

The pluripotent stem cell is the first in a sequence of steps of hematopoietic cell generation and maturation. The progenitor of all blood cells is called the multi potential hematopoietic stem cell. These cells have the capacity for self-renewal as well as proliferation and differentiation into progenitor cells committed to one specific cell line (Gamal,2014).

2-8-1: Hematopoietic Growth Factors:

The hematopoietic growth factors are glycoprotein hormones that regulate the proliferation and differentiation of hematopoietic progenitor cells and the function of mature blood cells. These growth factors were referred to as colony stimulating factors (CSFs) because they stimulated the formation of colonies of cells derived from individual bone marrow progenitors.

Erythropoietin, granulocyte-macrophage colony stimulating factors (GM-CSF) granulocyte colony stimulating factor (G-CSF), macrophage colony stimulating factor (M-CSF) and interleukin-3 are representative factor that have been identified, cloned and produced through recombinant DNA technology(Gamal,2014).

The hematopoietic growth factors interact with blood cells at different levels in the cascade of cell differentiation from the multi potential progenitor to the circulating mature cell (Gamal, 2014).

2-8-2: Hemoglobin Synthesis:

It occurs in the RBC precursors from the globin polypeptide chain and heme. This synthesis stops in the mature RBCs (Gamal, 2014).

Hb is a tetramer, formed of 4 polypeptide chains with a heme group attached to each chain. These polypeptides are of different chemical types. Each chain is controlled by a different gene, which is activated and inactivated in a special sequence. Alpha chain is controlled by two sets of gene (i.e. 4 genes), which are present on chromosome No.6. Beta, Gamma and Delta chains are controlled by one set of genes (i.e 2 genes) for each chain, which are present on chromosome (Gamal, 2014).

2-8-3: Development and Maturation:

Erythrocytes are rapidly maturing cells that undergo several mitotic divisions during the maturation process. The Pronormoblast" is the first identifiable cell of this line followed by the “Basophilic normoblast ", polychromatic norm oblast ", orthochromatic normocyte " and reticulocyte stages in the bone marrow. Reticulocytes enter the circulating blood and fully mature into functioned erythrocytes (Gamal, 2014).

A defect in nuclear maturation can occur. This is referred to as megaloblastic maturation. In this condition, the nuclear maturation, which represents an impaired ability of the cell to synthesize DNA, lags behind the normally developing cytoplasm (Gamal, 2014).

Reticulocytes represent the first no nucleated stage in erythrocyte development. Although the nucleus has been lost from the cell by this stage, as long as RNA is present, synthesis of both protein and heme continues. The ultimate catabolism of RNA, ribosome disintegration, and loss of mitochondria mark the transition from the reticulocyte stage to full maturation of the erythrocyte. If erythropoietin stimulation produces increased numbers of immature reticulocytes in the blood circulation, these Reticulocytes are referred to as stress or shift reticulocytes. Supravital stains such as new methylene blue are used to perform quantitative determination of blood reticulocytes (Gamal,2014).

2-9: Effect of Season on Blood Profile

The ideal ambient temperature ("thermos neutral" zone) for a cow is between 5°C and 25°C (Roth, 1998). As ambient temperature increases, it becomes more difficult for a cow to cool herself adequately and she enters heat stress. The hematochemical profile of an animal provides a reliable diagnostic tool for assessing the level of stress in an animal and its health status. The mechanism of effect of seasons on hemoglobin level as affected by seasons is still unclear. (Fadare et al. 2012). The values of 70ºF or less are considered comfortable, 75–78ºFstressful, and values greater than 78ºF cause extreme distresses with lactating cows being unable to maintain thermoregulatory mechanisms or normal body temperatures (Khadjeh et al, 2002).

The hematological profile is important for indicating animal physiological changes (Jain, 1993). Usually, blood examination is performed such as screening procedure to assess general health and welfare, but hematological values indicated adaptability to adverse environmental conditions (Wood and Quiroz-Rocha, 2010).

Seasonal and environmental changes may influence hematological values (Feldman et al., 2002).Thermal environment is a major factor that can negatively affect cow performance, especially in animals of high genetic

value (Hewett, 1974). The variation in environmental variables such as ambient temperature, relative humidity, wind and rainfall were recognized as the potential hazards in livestock growth and production. Some species have evolved endogenous annual rhythmicity as an adaptive mechanism to react in advance to regular environmental changes associated with the seasons (Piscineetal., 2009).

Hematological and biochemical aids have been used to identify status of cattle. The results showed a significant difference in most of the parameters due to the variation in ambient temperature, relative humidity and temperature-humidity index. A significant increase ($p<0.05$) in RBC, Hb, and HCT was recorded in winter season as compared to the summer season As the hematological and biochemical profiles of dairy cows has been altered in response to the different season which ultimately affected on the milk production (Vijay,2016). No significant effect ($P > .05$) of season was noticed on TEC, PCV, MCV and MCH. On the contrary, a few earlier published reports have demonstrated an increase in TEC due to heat stress in sheep (Fadare et al. 2012). This has been attributed to an adaptive mechanism in response to heat stress. The non-significant change in TEC, PCV, MCV and MCH during various seasons in the present study is suggestive of adaptability of Cholistani bulls to the harsh climatic conditions without being under stress (Farooq *et al.* 2012). These fluctuations during experimental periods can be attributed to changes in water balance. High environmental temperatures may lead to higher evaporative water loss through the skin surface, as well as the respiratory tract, thereby requiring compensatory water intake to regulate body temperature (Mustafa *et al*., 1977). The RBC, Hb and Hct heat-induced depression in cows exposed to high temperatures was probably associated to haemodilution effect, because more water was transported in circulatory system for evaporative cooling (El-Nouty*et al*., 1990).

These data confirm results obtained in previous studies (Gutierrez-De Lar *et al*., 1971; Casella *et al*., 2013) their results showed a decrease in PLT values associated with the rise in temperature, this reduction can be due to high ambient temperature that is the main environmental stressing factor (Casella *et al*., 2013). All hematological data obtained in the their study are within the physiological range for cattle (Weiss and War drop, 2010) and agree with the findings of other studies carried out on As promoting and Gargantuan breeds (Piccione *et al*., 2014).

CHAPTER THREE

MATERIALS AND METHODS

3-1 The Study Area

The experiment included two farms research centers, which are Animal Production Research Center (kuku in Khartoum) representing crossbreeds (*Friesian x kenana*) and Animal Production Research Center (Om Beninin Singa)representing purebreds(*Kenana)*

3-2 The experimental Animal

For the present study, a total number of 20 dairy cows crossbreeds (*Friesian, kenana*) and pure breed (*Kenana)* (4–7 years old), were selected individually and randomly from each. The examined animals were distributed into two groups. Group 1 included 10 cattle from crossbreeds (*Friesian, kenana*) and Group 2 included 10 cattle from pure breed (*Kenana)* .

3-3 Blood Collection and Analysis

The samples of blood were collected during two seasons (summer and winter seasons) and the blood samples were drawn from the jugular vein of each cow. 5 ml of blood were collected into test tubes with EDTA as an anticoagulant. Then the obtained samples from Animal Production Research Center kuku in Khartoum were taken immediately to the laboratory but the obtained samples from Animal Production Research Center Om Benin in Singha were saved in a container containing ice and transported to the laboratory in the next morning.

The following hematological parameters were analyzed for concentrations of red blood cell count (RBC), hemoglobin concentration (HGB),hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin(MCH), white blood cell count (WBC) including eosinophils, basophils, neutrophils ,lymphocytes and monocytes, and blood

platelets (PLT). All parameters were analyzed with the device Automated Hematology Analyzer, company: Urit Medical Electronics co. Ltd. Model: URIT – 3010 vet. The analysis were conducted in the laboratories at the

3-4 Milk production:

The data for milk production were collected from records of two research centers farms.

3-5 Statistical Analysis

The analysis process was done using SPSS .The data were analyzed using Factorial Experimental Designs. To comp are means between the two groups. The differences among group means were examined by ANOVA Result was expressed as mean ± standard error (SE); P-value < 0.05 was considered assignificant. T. test was used to analyze the milk production.

CHAPTER FOUR

RESLUTS

Blood profile of Kenana and Cross breed (Kenana x Friesian)) were studied in two seasons (Summer and Winter) and determined some parameters such as: red blood cell count (RBC), white blood cell count (WBC), hemoglobin concentration (HGB), hematocrit (HCT), mean corpuscular volume (MCV), Mean Cell hemoglobin (MCH), blood platelets (PLT),Lymphocytes Percentage (LYM), Mid Cells Percentage (MID%), Granulocytes Percentage (GRAN%), Lymphocytes total count (LYM), Mid Cells total count (MID), Granulocytes total count (GRAN), Hematocrit percentage (HCT%), Mean Cell hemoglobin (MCH), Mean Cell hemoglobin concentration (MCHC), Red blood cell distribution width- cell volume percentage (RDW-CV%), Red blood cell distribution width -size distribution (RDW-SD), Mean platelet volume (MPV), and Red cell distribution width (RDW).

The data has disclosed results that revealed the effects of season on blood profile of Kenana and Cross breeds (F*K) as following:

The data in table(1) revealed that in summer season there were no significant difference in all parameters except Red Blood Cell(RBC), Hemoglobin (HGB) and Hematocrit (HCT) which were significant difference ($P \leq 0.05$) when compared between the two breeds. On the other side in winter season just Mid-range percent (MID%), mid-range absolute count (MID#) and Red cell distribution width coefficient of variation(RDW-CV) were found significantly difference ($p \leq 0.05$) between Kenana and Cross breds. and also there were high significant difference ($p \leq 0.01$) in Red Blood Cell(RBC), Hemoglobin (HGB) and Hematocrit (HCT) in Comparison between Kenana and cross bred in winter season and all were in favour of Kenana breed except RDW-CV was in favour of cross breed.

Table (4:1): Effect of season on blood profile of Kenana and Cross breeds

Parameters	(Mean ±SE) SUMMER SEAS0N		Sig	Mean ±SE WINTER SEASON		Sig
	Kenana	Cross		Kenana	Cross	
WBC* 10^9/L	10.45±1,10	9.35±1.25	NS	13.14±1.86	9.03±0.76	NS
LYM%	24.23±1.21	21.87±1.74	NS	48.32±2.53	45.10±2.52	NS
MID % H	21.30±1.66	16.41±1.95	NS	16.98±0.74	13.73±1.09	*
GRAN%	54.47±2.67	61.72±3.39	NS	34.70±2.72	41.17±2.83	NS
LYM#* 10^9/L	2.43±0.26	1.99±0.36	NS	6.39±1.12	3.97±0.33	NS
MID#* 10^9/L H	2.15±0.26	1.46±0.39	NS	2.15±0.29	1.22±0.18	*
GRAN#* 10^9/L	5.87±0.70	5.81±0.79	NS	4.60±0.68	3.84±0.40	NS
RBC* 10^12/L	6.55±0.36*	5.45±0,25	*	7.20±0.37	5.36±0.24	**
HGB g/Dl H	10.64±0.67*	8,59±0.37	*	14.87±1.59	10.02±0.55	**
HCT%	35.33±2.50*	28.27±1.40	*	37.42±1.79	28.23±1.74	**
MCVfl	53.88±1.70	51.01±1.27	NS	52.36±1.79	52.56±1.58	NS
MCHpg	16.18±0.37	15.42±0.19	NS	20.79±2.26	18.64±0.43	NS
MCHC g/dl	30.22±0.36	28.18±2.23	NS	40.28±4.85	35.61±0.39	NS
RDW-CV%	15.41±0.23	15.91±0.20	NS	15.30±0.30	16.29±0.35	*
RDW-SDfl	28.47±0.88	27.56±0.72	NS	27.40±1.11	28.86±0.97	NS
PLT* 10^9/L L	152.50±31.52	150.40±33.19	NS	192.00±38.23	242.60±27.9	NS
MPVfl H	11.88±0.62	9.72±1.21	NS	10.61±0.43	9.83±0.43	NS
PDWfl	5.66±1.96	7.83±2.1 6	NS	7.89±1.80	10.72±0.61	NS

NS: Non Significant.
*: Significant ($p \leq 0.05$).
**: high Significant ($p \leq 0.01$).

When we comparing the effect of season with in group (Kenana cattle) it was discovered that there were no significant difference between summer and winter season in all Parameters except Mid-range percent (MID %) was significant difference ($p \leq 0.05$) and Granulocyte percent (GRAN %) was high significant difference ($p \leq 0.01$) and both parameters were high in summer season. Also in winter season Hemoglobin (HGB) was significantly difference ($p \leq 0.05$) and Lymphocyte percent (LYM %) and Lymphocytes (LYM#) were high significant difference ($p \leq 0.01$) as in the following table.

Table (4:2): Effect of season on blood profile of Kenana breedcattle.

Parameters	(Mean ±SE) Kenana breed		Sig
	Summer	Winter	
WBC* 10^9/L	10.45±1.10	13.14±1.86	NS
LYM%	24.23±1.12	48.23±2.53**	**
MID % H	21.30±1.66*	16.98±0.74	*
GRAN%	54.47±2.67**	34.70±2.72	**
LYM#* 10^9/L	2.43±0.27	6.39±1.12**	**
MID#* 10^9/L H	2.15±0.26	2.15±0.29	NS
GRAN#* 10^9/L	5.87±0.70	4.60±0.68	NS
RBC* 10^12/L	6.55±0.36	7.20±0.37	NS
HGB g/Dl H	10.64±0.68	14.87±1.59*	*
HCT%	35.33±2.50	37.42±1.79	NS
MCVfl	53.88±1.70	52.36±1.79	NS
MCHpg	16.18±0.37	20.79±2.26	NS
MCHC g/dl	30.22±0.36	40.28±4.85	NS
RDW-CV%	15.41±0.23	15.30±0.30	NS
RDW-SDfl	28.47±0.88	27.40±1.11	NS
PLT* 10^9/L L	152.50±31.53	192.00±38.26	NS
MPVfl H	11.88±0.62	10.61±0.43	NS
PDWfl	5.66±1.96	7.89±1.80	NS

NS: NonSignificant.
*: Significant ($p \leq 0.05$).
**: high Significant ($p \leq 0.01$).

moreover when the compared effect of season within group (Cross bred cattle) as in the data in table (4.3) disclosed that more than half of parameters were not significant differences, but on the other hand there were highly significant different ($p \leq 0.01$) between the two seasons in means of Lymphocyte percent (LYM%), Lymphocytes (LYM#), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC). Also Hemoglobin (HGB) and Platelet count (PLT) were significant difference ($p \leq 0.05$) all in favor of winter season. Else in summer season Granulocyte percent (GRAN %) was high significant difference ($p \leq 0.01$) and Granulocyte absolute count (GRAN#) was significant difference ($p \leq 0.01$) more than winter season.

Table (4.3): Comparison between summer and winter seasons on blood profile of Cross breed.

Parameters	Mean ±SE		Sig
	Cross breed		
	Summer	Winter	
WBC* 10^9/L	9.35±1.25	9.03±0.76	NS
LYM%	21.87±1.74	45.10±2.52**	**
MID% H	16.41±1.95	13.73±1.10	NS
GRAN%	61.72±3.40**	41.17±2.83	**
LYM#* 10^9/L	1.99±0.36	3.970±0.33**	**
MID#* 10^9/L H	1.46±0.39	1.22±0.18	NS
GRAN#* 10^9/L	5.81±0.79*	3.84±0.40	*
RBC* 10^12/L	5.45±0.25	5.36±0.24	NS
HGB g/Dl H	8.59±0.37	10.02±0.55*	*
HCT%	28.27±1.40	28.23±1.74	NS
MCVfl	51.01±1.27	52.56±1.58	NS
MCHpg	15.42±0.19	18.64±0.43**	**
MCHC g/dl	28.18±2.23	35.61±0.39**	**
RDW-CV%	15.91±0.20	16.29±0.35	NS
RDW-SDfl	27.56±0.72	28.86±0.97	NS
PLT* 10^9/L L	150.40±33.18	242.60±27.96*	*
MPVfl H	9.72±1.21	9.83±0.43	NS
PDWfl	7.83±2.16	10.72±0.61	NS

NS: Non Significant.
*: Significant ($p \leq 0.05$).
**: high Significant ($p \leq 0.01$).

Milk production:

The data in table (4.4) projected that there were significant different ($p \leq 0.05$) between the two breeds. The overall mean milk production per day , month and yield were8.15±.43 , 227.0±10.78 and 1816.0±86.28 liters for Kenana breeds and 9.56±.38 , 291.78±17.12 and 2526.78±291.89 liters for cross breed srespectively, this revealed that crossbreeds produce more milk ($P>0.05$) than the Kenana breeds. It was observed that cross processing of breeds in creased milk yield. Also there were significant different ($p \leq 0.05$) between the two breeds in Lactation Length. The overall lactation period was8.0 ±0.12months in Kenana breeds and 10.0±0.52months in crossbred.

Table (4.4):Milk production of the breeds:

Items	Breeds	Mean± Std.Error	Sig
milk production per day/Liter	Kenana	8.15±.43	.*
	Crossbred	9.56±.38	
milk production per month/ Liter	Kenana	227.0±10.78	*
	Crossbred	291.78±17.12	
Milk yield/liter	Kenana	1816.0±86.28	*
	Crossbred	2526.78±291.89	
Lactation Length/ Month	Kenana	8.0 ±0.12	*
	Crossbred	10.0±0.52	

*: significant ($p \leq 0.05$)

CHAPTER FIVE

DISCUSSION

The hematological profile is important for indicating animal physiological status (Jain, 1993). Usually, blood examination is performed such as screening procedure to assess general health and welfare, but hematological values indicated adaptability to adverse environmental conditions (Wood and Quiroz-Rocha, 2010).

Blood profile of Kenana and Cross breed (Kenana x Friesian) were studied in two seasons (summer and winter), However, to the best of our knowledge, no such work has been reported for Kenana and cross breeds (Friesian* kenana) have been done for complete blood count (CBC) studies. The data obtained for the Kenana and cross breeds are the first reference values to be published. According to previous studies our findings highlighted that the influence of seasons to breeds should be considered when evaluating blood Parameters. We have earlier reported seasonal variations in CBC traits. No enough data is available in blood profile of Kenana and cross breed for comparison of our results. The data has disclosed results that revealed the comparison between two breeds and effects of season on blood profile of Kenana and Cross breeds revealed that in summer season there were no significant difference between two groups in all parameters except (some parameters) Red Blood Cell (RBC), Hemoglobin (HGB) and Hematocrit (HCT) which were significant difference ($P \leq 0.05$) when compared between two breeds, which indicated the innate adaptability of the cross breed to the harsh climate. The RBC count in Kenana breed showed a significant increase with concomitant significant changes in HGB and HCT during summer season in comparison withcross breedsseason. and this variation may be attributed to the hematological profiles of dairy cows has been altered in response to the different season. And also as Koubkova et al (2002) reported:

cows exposed to high temperatures was probably associated to haemodilution effect, because more water was transported in circulatory system for evaporative cooling. High environmental temperatures may lead to higher evaporativewater loss through the skin surface, as well as the respiratory tract, thereby requiring compensatory water intake to regulate body temperature (Mustafa et al., 1977; Ogebe et al., 1996)

On the other side we found in winter season just Mid-range percent (MID%), mid-range absolute count(MID#)and Red cell distribution width coefficient of variation(RDW-CV) showed a significant increase($p \leq 0.05$) between Kenana and the Cross breeds, comparison with the Red Blood Cell(RBC), Hemoglobin (HGB) and Hematocrit (HCT) showed highly significant increase ($p \leq 0.01$) in comparison between Kenana and the cross breeds in winter season and all were in favour of Kenana breed except RDW-CV was in favour of the cross breed. The lack of differences in the environmental variables among the two breeds suggests that the differences found in hematological parameters studied in cattle groups were attributable exclusively to the different cattle breed and seasons and adaptive mechanism in response to heat stress.

When comparing the effect of season within group for Kenana cattle, it was discovered that there were no significant difference between summer and winter season in all Parameters except Mid-range percent (MID%) was significant difference ($p \leq 0.05$) and Granulocyte percent (GRAN%) was high significant difference($p \leq 0.01$) and both parameters were high in summer season, Also in winter season Hemoglobin (HGB) was significant difference ($p \leq 0.05$) and Lymphocyte percent (LYM%) and Lymphocytes(LYM#) were high significant difference ($p \leq 0.01$). those results are in contrast with Vijay,(2016) who reported that the results showed a significant difference in most of the parameters due to the variation in ambient temperature, a significant increase ($p<0.05$) in RBC, Hb, and HCT was recorded in winter

season as compared to the summer season. As the hematological profiles of dairy cows has been altered in response to the different season.

Also when we compared the effect of season within group for Cross breed, it disclosed that more than half of parameters were not significant differences, but on the other hand there were highly significant different ($p \leq 0.01$) between two seasons in means of Lymphocyte percent (LYM%), Lymphocytes (LYM#), Mean Corpuscular Hemoglobin(MCH) and Mean Corpuscular Hemoglobin Concentration(MCHC) ,This results disagree with Farooq et al. (2012) who reported; non-significant change in PCV, MCV and MCH during various seasons in their study on Cholistani bulls to the harsh climatic conditions without being under stress is suggestive of adaptability. found the Hemoglobin (HGB) and Platelet count (PLT) were found significant difference ($p \leq 0.05$) increased , all in favor of winter season, the result of PLT is agree mead with the findings of Casella et al., (2013) who reported that there was a decrease in PLT values associated with the rise in temperature, This reduction could be due to high ambient temperature that is themain environmental stressing factor. Else in summer season Granulocyte percent (GRAN %) was highly significant different
($p\leq 0.01$) and Granulocyte absolute count (GRAN#) was significant different ($p \leq 0.01$) more than winter season. All hematological data obtained in the present study are within the physiological range for cattle.

For milk yield, crossbreed(F*K) produce more milk ($P>0.05$) than Kenana breed. Milk yield for Kenana was 1816.0±86.28 liters, This results agreement with the pervious findings of that reported by Abdel Rahman ,(2007) Mean lactation milk yield of Kenana cows is 1836±186 liters. On the other hand our mean values of lactation period were shorter than Abdel Rahman (2007) who reported lactation length of 308±6 days (10 months).The lactation length in this study also is in agreement with the pervious findings of that reported byDunn et al,(1969)who mentionedthe milk yield per lactation in Kenana cows ranging from 1200 to 4500kg in an average lactation period

of 240 days(8months).The overall mean milk yield were1816.0±86.28 liters for Kenana breeds and 2526.78±291.89 liters forcross breeds, this revealed that crossbreeds produce more milk (P>0.05) than the Kenana breeds. It was observed that cross processing of breedsincreased milk yield, this agree with Yousif et al,(1998) who explained that milk yield of crossbred cows was significantly influenced by percentage of foreign blood.

Milk production per day in this results were less than (Abdalla et. al, 1990 ; Mohammed et. al, 1991 ; Musa, 2001 ; Ageeb and Hillers ,1991). (Douglas, G.H and Ginther, 1973) who reported from Ombenen livestock center that there were few Kenana cows yield up to 50 Ib of milk per day. The milk production per day in this study were find in crossbreed (9.56±0.38) liter day, this result in this study crossbreed milk production per day. Disagreemint with the reported by Abdelmasea (1988) who stated that the highest average daily production were reached in foueth lactation season on greeted cattle 15.5± 2 kg cow day

CONCLUSION AND RECOMMENDATION

Conclusion

Results of this study concluded:

1. The cross breed (Holstein Frisian * Kenana) proved to be highly adaptable to harsh climatic conditions and resistant to common diseases prevalent in Sudan.
2. Blood components have no effect on the amount of milk produced in cows.
3. There are no differences in blood components between the local breed (kenana) and the cross breed (Holstein Frisian * Kenana).
4. Since blood components are not the main cause of increased milk production may be due to genetic genes.
5. Blood profile did not change the level of milk production.

Recommendation:

This study would recommend:

1. Giving more attention to kenana local cows.
2. Giving more studies on blood parameters .
3. Study the effect of genetics on increasing milk production in the local breed (kenana) and cross breed (Holstein Frisian * Kenana).
4. Management must be considered to obtain better results response.
5. Give greater attention to genetic studies in animals and all related to the aim of improving the production of agricultural animals in Sudan.

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