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Effects of Flushing And Supplementation With Selenium And Vitamin E On Reproductive Performance Of Two Sudanese Desert Sheep Ecotypes (Dubasi And Ashugar) DuringThe Dry Season

تأثير نظم الدفع الغذائي المعزز بالسلينيوم وفيتامين (E) على الأداء التناسلي لسلالتين من الضأن الصحراوي السوداني (الدباسي والأشقر) أثناء موسم الجفاف

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DEDICATION

To My lovely Wife and kids

To my brother and sisters

To My teachers and lecturers

To my friends

With best wishes

Lieri

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Abstract:

This study was conducted to evaluate the effects of two flushing systems (high concentrate + moderate concentrate) and three supplementation levels of Selenium (Se) plus vitamin E on reproductive performance of Gezira desert sheep (Shugor and Dubasi) under Gezira area and similar ecological zones. The objectives of this study are to improve Gezira desert sheep reproductive performance and to help maximize overall production efficiency. Thirty six mature ewes ecotype (Dubasi and Shugor) of age 2 to 3 years and average initial body weight of 36kg and four rams of 3 to 4years of age and average body weight of 45kg were kept in Rural Development and Extension Center in Al-Managil. Three planes of nutrition were used (A control- concentrate diet containing 13% CP and 11.5MJ/kg DM of metabolizable energy – ME. A moderate concentrate diet containing 16%CP and 12.8MJ/kg DM of ME and a high concentrate diet containing 18%CP and 13.3 MJ/kg DM of ME in addition to Groundnut hulls as a roughages diet. Three levels of Se and vit.E, were used with were three rations for all treatments, which were formulated to supply (13–18) % CP and (11.5-13.3) MJ/Kg DM. The experimental animals were divided randomly into six groups of 3 animals per group. The effect of flushing systems on ewes reproductive performance indicated that flushed ewes had higher oestrus rate ($P \leq 0.05$), higher ovulation rate ($p \leq 0.05$) and higher conception rate ($P \leq 0.05$). They also had reduced abortion rate ($P \leq 0.05$) and minimized pregnancy stresses and had no ewes mortality. Abortion rate of 33% was reduced in the control group of Dubasi. The gestation period for all flushed animals ranged between 148 to 151days, with no significant differences ($P \geq 0.05$). The effects of flushing systems and supplementation levels of Se+ vit.E recorded also higher fertility percentage ($P \leq 0.05$), higher lambing rate ($P \leq 0.05$) and higher litter size ($P \leq 0.05$) and also recorded higher ($P \leq 0.05$) lamb birth weight ($P \leq 0.05$) and higher pre-weaning growth rate at age of 30-60 and 120 days. The results of this study for haematological parameters indicated that Shugor ewes recorded high significant difference ($P \leq 0.05$) for haemoglobin concentration while Dubasi recorded non-significant difference. Results of white blood cells showed high significant difference ($P \leq 0.05$) for both ecotypes. The highest mean values for RBC were recorded for moderate conc., high conc. and high conc. + full dose of selenium groups. A high significant difference at ($P \leq 0.05$) was recorded for PCV percent for Shugor ecotype. The highest mean value were recorded for high conc. and high conc. + full dose of selenium experimental groups. The effects of the flushing systems and supplementation levels of Se+ vit.E on serum blood components (biochemical parameters) indicated higher significant ($P \leq 0.05$) total protein,

higher (P≤0.05) total albumin and higher (P≤0.05) glucose in the third month for both ecotype. Cholesterol recorded a high significant difference (P≤0.05) in the second and third months for both ecotypes. Phosphorus recorded high significant difference (P≤0.05) in the first, second and third month, while Dubasi recorded non-significant difference. Calcium recorded a higher significant difference (P≤0.05) for Dubasi, while Shugor recorded significant difference (P≤0.05) in the first month only. In general, flushing regime increased these metabolites associated with improvement in production capabilities, reproductive performance and positive energy balance in small ruminants.

ملخص الدراسة:

أجريت هذه الدراسة لتقييم تأثير نظامين للدفع الغذائي وثلاثة مستويات من عنصر السيلينيوم بالإضافة لفايتامينEعلى الأداء التناسلي للضأن الصحراوي السوداني (الدباسي و الأشقر) تحت ظروف وبيئة الجزيرة. الأهداف من هذه الدراسة هو تحسين الأداء التناسلي ورفع الكفاءة التناسلية للضأن الصحراوي في منطقة الجزيرة. إستخدم لهذا البحث عدد 36 رأس من نعاج الدباسي والأشقر الناضجين عند عمر 2الى 3 سنوات وكان متوسط وزن النعاج عند بداية التجربة هو 36 كجم مع وجود أربعة كباش للتلقيح عمرها ما بين 3 الى 4 سنوات ومتوسط وزنها عند بداية التجربة يعادل 45 كجم. تم حفظ هذه الحيوانات في مركز المناقل للإرشاد والتنمية الريفية. تم تركيب العلائق المركزة لمقابلة مستويين من الدفع الغذائي قبل وبعد الشياع وثلاثة مستويات لعنصر السيلينيوم وفايتامينE كانت العلائق المركزة تحتوي على 13إلى 18% بروتين خام و 11.5 الى 13.3ميقاجول/كجم مادة جافة. تم توزيع حيوانات التجربة بطريقة عشوائية إلى ستة مجموعات وتحتوي كل مجموعة على عدد 3 نعاج. إتضح أن تأثير الدفع الغذائي على الأداء التناسلي في معدلات دورة الشياع والتبويض والحمل كانت جميعها معنوية ($P\leq0.05$) كما إن مستويي الدفع الغذائي أديا الى تقليل الإجهاض وتقليل مضاعفات الحمل، كما أنه لم يتسبب في نفوق النعاج وقلل معدل الإجهاض الذي كان 33% في مجموعة الشاهد لسلالة الدباسي. إن طول فترة الحمل في جميع الحيوانات قد نقص ليتراوح بين 148 الى 151. كما إن مستويي الدفع الغذائى والثلاث مستويات الخاصة بالسيلينيوم وفايتمينE كان تأثيرها أعلى على الخصوبة ($P\leq0.05$) و معدل الولادة ($P\leq0.05$) وعدد المواليد للنعجة الواحدة ($P\leq0.05$) وعلى وزن الحملان عند الميلاد ($P\leq0.05$) وأعلى معدلات النمو عند عمر 30 الى 60يوم ($P\leq0.05$) وأيضاً عند عمر 120يوم ($P\leq0.05$) بالنسبة لمستوى الهيموغلوبين فإن الضأن الأشقر قد سجل فروقات معنوية ($P\leq0.05$) بينما ضأن الدباسي لم يسجل أي فروقات معنوية في مستوى الهيموغلبين. لقد تم تسجيل تأثير معنوي ($P\leq0.05$) بين كل المعاملات في خلايا كرويات الدم الحمراء وكان أعلى متوسط لهذه الخلايا قد سجل لمعاملات عليقة تركيز وسط وعليقة تركيز عالي وعليقة تركيز عالي + عنصر السلينيوم وفايتمين E وقد تم تسجيل فروقات معنوية ($P\leq0.05$) ل PVC للأشقر وكان أعلى متوسط قد تم تسجيله للمعاملات عليقة تركيز عالي وعليقة تركيز عالي + جرعة كاملة من عنصر السيلينيوم وفايتمين E. إن تأثير مستويي التغذية وثلاث مستويات السيلينيوم + فايتامينE على مكونات سيرم الدم (مؤشرات بايوكيميائية) كان معنوياً ($P\leq0.05$) على البروتين الكلي والألبيومين ($P\leq0.05$) والجلوكوز ($P\leq0.05$) وذلك في الشهر الثالث لسلالتي الدباسي والاشقر أما الكلوسترول فقد كانت هناك فروقات بين مستويات المعاملات ($P\leq0.05$) وذلك في الشهر الثاني والثالث للسلالتين. أما الفسفور فقد سجل فروقات معنوية بين المعاملات التجريبية في الشهر الاول والثاني. كما سجل عنصر الكالسيوم فروقات معنوية ($P\leq0.05$) بين المستويات التجريبية للدباسي أما الأشقر فقد سجل فروقات معنوية في الشهر الاول فقط. بصفة عامة فإن مستويي الدفع الغذائي وثلاثة مستويات الخاصة السيلينيوم + فايتامين E قد غيرت الخواص الأيضية للنعاج المستخدمة في هذه التجارب فقد زادت مستويات سيرم الدم والألبيومين والبروتين الكلي والكلوسترول الكلي والتراي-جلوسرايد والكالسيوم والفسفور. إن الزيادة في هذه المكونات قد صاحبتها زيادة في الإنتاج الكلي والأيض الهضمي والأداء التناسلي وكان له تأثير إيجابي على ميزان الطاقة في المجترات الصغيرة.

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LIST OF ABBREVIATIONS

Abbrev.	Denotation
CFM	Concentrate Feed Mixture
FAO	Food and Agriculture Organization
GH	Groundnut Hay
Hb	Hemoglobin
Alb	Albumin
Kg	Kilogram
MAR	Ministry of Animal Resources
MARF	Ministry of Animal Resources and Fisheries
Mg	Milligram
N.S	Non Significant
PCV	Packed Cell Volume
PHGPx	Phospholipid Hydroperoxide Glutathione Per-oxidase
ppm	Parts Per Million
RBC	Red Blood Cell
S.E	Standerd Error
Se	Selenium
SeCys	SelenoCysteine
SEM	Standard Error Means
Sig	Significant
Tp	Total protein
VA	Vitamin A
WBC	White Blood Cell
WR	Working Reagent
Conc.	Concentrate

Con.	Control
Vit.	Vitamin
mg/dl	Milligrams per decilitre
g/dl	Grams per decilitre

CHAPTER ONE

INTRODUCTION

Sudan has the largest livestock population in Africa and according to estimates of (MARF, 2016), the total livestock population were about (106.6 million heads) of which 30.37 million heads of cattle, 40.21 million heads of sheep, 31.22 million heads of goats and 4.80 million heads of camels. The livestock are under traditional nomadic system in which animals are expected to tend for themselves to a large extent and to contest with environmental stresses imposed on them by nature. There are four types of Sudanese sheep (Desert, Nilotic, Arid upland and Equatorial upland) and seventeen breeds (El-Hag, 2001). Sudan desert sheep breed is one of the most important meat and milk producing sheep in Sudan and represent more than 65 percent of the total sheep in Sudan and nearly 100 percent of Sudanese sheep exports (El-Hag *et al*., 2001). Sudan export live sheep and sheep meat to Saudi Arabia, Libya, United Arab Emirate and Jordon (ARSC, 2004). The Ministry of Animal Resources estimated a total milk production from sheep at 650000 tons or roughly 9 percent of Sudanese total milk production (Abdelgadir *et al*., 1998).

Nomadic desert sheep are raised under open rangeland and obtain adequate feed from grazing during rainy season, but are on the verge of starvation during the dry season. Dry season pasture does not meet the maintenance requirements of sheep and may lead to loss of weight and mortality in young animals. Transhumant's and sedentary farmers raise desert sheep (Dubasi and Shugor ecotypes) to produce meat, milk and to a lesser extend skin (Abdelgadir *et al*., 1998). The traditional village base system of sheep rasing is usually associated with large irrigated areas, where a few heads of goats, sheep or cattle may be kept. Grazing on range, fallow-land and along irrigation canals plus house waste, crop residues, and agro-industrial by-products which constitute an important source of

feeding-stuffs for livestock. Darrage, (1995) noted that the introduction of livestock into crop rotation in Gezira scheme, the largest irrigated agricultural scheme in Sudan, has been an attempt with the objective of improving the socio-economic conditions of livestock keepers and to ensure adequate supply of neighbouring towns with meat, milk and other animal products. The sedentary desert sheep (Dubasi and Shugor ecotypes) production is of great importance to Sudanese economy as it is one of the main sources of food, employment and hard currency. Sheep industry play an important role in the country as available strategic resources for both local and export purposes, and play an important role in sustainability of village communities and in many cases form a major source of income.

Sheep are well known for feeding on a wide spectrum of plants, and are said to possess some degree of nutritional wisdom which enable them to select food that meet their nutritional needs and avoid those that cause toxicosis (Provenza *et al*., 1994 a,b). It is generally agreed that inadequate nutrition is one the main factors accounting for low sheep productivity in the country. The potential of any feed to support animal production depends on the quantity consumed by the animal and extent to which the feed meet energy, protein, mineral and vitamin requirements (Minson, 1990). Nutrition is one of the environmental cues that affect reproduction in domestic animals (Tatman *et al*., 1990). Direct effects of poor nutrition are reflected in reduced conception, embryonic losses, reduced lambing rate (Diskin and NisWender, 1989), and high ewe mortality (Yoder *et al*., 1990). Low lambing rate represent a major obstacle to sheep production (Schoenian and Burfening, 1990).

It is widely accepted practice in sheep production to provide ewes with extra energy supply (flushing) for 2-3 weeks prior to and during breeding, for the purposes of increasing the number of lambs produced. The ability of nutrition around the time of mating to alter ovulation and

lambing rates of ewes in many breeds is well known (O'Callaghan and Boland, 1999). Working with a British breed, Rhind *et al* (1989) stated that low feed intake before mating reduced the mean ovulation rate and low intake after mating induced a high rate of ova wastage. It is evident that failure to flush ewes may result in delayed estrus (Gunn *et al*., 1979), fertilization failure (Restall *et al*., 1978) and embryonic mortality (Rhind *et al*., 1989).

Imbalances in trace minerals may occur in farm animals, especially sheep, whose intake of minerals depend largely on the content in the forage and thereby on the soil where lay grows. Sudan as many other countries in the world has low content of Selenium (Se) in the soil. Animals that mainly consume home produced roughages therefore easily suffer from Se deficiencies, if they are not supplemented in an appropriate way. Selenium is an important trace element that has a narrow range between deficiency and toxicity in sheep (Humann ziehanka *et al*., 2013).

Serious Se deficiency can lead to nutritional muscular-dystrophy (NMD), also called white muscle disease, but more common are the sub-clinical symptoms such as weak lambs, reduced feed consumption and pregnancy complications (NRC,2007). Selenium deficiency plays a role in numerous economically important livestock diseases and problems that include impaired fertility, abortion, retained placenta, and neonatal weakness (McDowel *et al*., 1996). Moreover, Selenoproteins are involved in immune and neuropsychological functions in nutrition of animals (Meschy, 2000). Selenium is also associated with thyroxin, Thyroid hormones that regulate metabolism, reproduction, circulation and muscle function. Selenium protects the body from heavy metals by forming complexes to radder their harmless. Selenium has a biological function related to vitamin E. in that Se is an essential component of glutathione peroxidase, an enzyme involved in detoxification of hydrogen peroxide

and lipid hydroperoxides. Vitamin E. requirement may therefore be defined as the amount required for preventing peroxidation in the particular sub- cellular membrane which is most susceptible to peroxidation. Se and vitamin E. have a close relationship with each other (Moeini *et al*., 2011). They exert similar antioxidation effects on cells via independent, biochemical pathways and indifferent locations (Hamam and Abou-zeina, 2007).Vitamin E. is an antioxidant that prevents the oxidative damage of the sensitive membrane lipids. Some literature cited variety of deficiency symptoms due to suboptimal vitamins content of the food. These symptoms include decreased growth rates, lowered fertility and impairment of the immune system, and finally increased susceptibility to secondary infections (Blowey, 1993).

Several studies have determined that injections of supplemental Se solution increased serum and tissues concentration of the element and serum or plasma. Selenium concentration provides a good indication of selenium status in ruminants (Pastrana *et al*., 1991 and Andres *et al*., 1996). Gabryszuk and Klewiec (2002) reported that the administration of Se improve the daily weight gain in lambs, and reproductive performances in ewes. This study arise from an interest in studying the interactions between different flushing systems and different levels of Se and vitamin E. supplementations and their functions, importance for production, reproduction and blood components of desert sheep of Sudan, and also to evaluate the effects of strategic supplementary feeding prior to mating (flushing) and injecting different levels of Se and vitamin E. on ewes in late wet season. The ultimate goal was to improve Sudan desert sheep (Dubasi and Shugor ecotype) productive and reproductive abilities in Gezira and similar ecological zones. The aim of this research is to collect information and present recommendations of the best flushing system, best level of Se and vitamin E. supplementation for Sudanese desert sheep.

The research justifications are:

1- Infertility is a common problem in Sudanese desert sheep.
2- Sheep reproductive performance in Sudan is affected by season and nutrition.

The main objectives of the study are to:

1- Investigate the reproductive potential of Sudan desert sheep eco-types under different flushing regimes and different selenium doses.
2- Compare reproductive parameters between two ecotypes of Sudan desert sheep.
3- Study the effects of different flushing systems and selenium and vitamin E supplementations on blood characteristics.
4- Complement the previous research done on the males (Rams).

CHAPTER TWO
LITERATURE REVIEW

2.1 Sheep production

Sudan, the African-country, has one of the largest livestock populations in the continent, according to FAO (2015) sheep has large population estimated by 1172.8 million head in the world. The numbers of livestock species were estimated at about (106.6 million heads), of which 30.37, 40.21, 31.22 and 4.80 million head of cattle, sheep, goats and camels, respectively (MARF, 2016). Livestock in the Sudan satisfies the internal demand and leaves substantial excess for export, which represents about 22% of the country's total exports. Livestock industry is of great importance to Sudanese economy as it is one of the main sources of food, employment and foreign currency. Ali (2003) mentioned that in spite of this economic importance most sheep are still raised under nomadic conditions with traditional methods of management and natural grazing (FAO, 1985). Over the same period, the number of sheep has grown at 2.8% per year, and so the proportion of sheep in Sudan's livestock population has remained constant at about 36%. Sheep therefore, play an important social and economic role in the country, and they are valuable strategic resources for both local and export purposes. In order to increase the livestock production potential, more emphasis is required on the selection of improved animal breeds with better performance (Matika *et al*., 2003; Isani *et al*., 2012).

Sheep occupies first place in terms of the census of animals in Africa and the Arab world. Sheep can live and produce under harsh environmental conditions. The distribution of Sudanese sheep in the different states is as follows: Northern Kordofan (13.87%), Southern Kordofan (5.95%), Western Darfur (7.50%), Northern Darfour (7.22%),

Gezira (4.75%), and Khartoum (0.85%) while the other states produce 59.86% (Ministry of Animal Recourse, 2008). In addition, they estimated sheep meat for exportation during the periods (1997–2002) as 705000 tons, (Ministry of Animal Recourse 2011).

2.2 Domestication

The sheep was originally a hairy animal with an under fur of wool. No doubt people living in cold climates who used skins as clothing were the first to begin the selection of sheep for wool production. As in all our domesticated animals, there is wide variation among sheep. Some, like the African long-legged and Abyssinian maned sheep, bear hair instead of wool, some have spiral horns 2feet or more in length, other no horns at all. The tail of the common domesticated sheep is long and slender, in some others strains it is a fat depot about 1 foot in width, whereas still others have merely a vestige of a tail. The last sort often carry huge patches of fat on the rear quarters, the stored fat in all cases serving to tide the animal over periods of food shortage.

2.3 Classification

Sheep belongs to the sub-family caprinae, family bovidae and all domesticated sheep are included in the genus *ovis aries*. Williamson and Payne (1977) mentioned that there were four major species of wild sheep: the moufflon (*Ovis. musimon*), the urial (*O. orientalis*), the argali (*O. ammon*) and the bighorn (*O. Canadensis*).

Sheep and goats belong to the tribe caprinae in the family bovidae in the sub-order Ruminantia in the order Artiodayla (Wilson, 1991 and Ryder, 1984). The tribe is composed of five genera, two of which are true goats; one genus (ovis) is for sheep and two genera (Ammotrasus and Pseudpis) are sheep – like goats. Variations in the classification of sheep are the greatest among farm animals (Devendra and Mcleory, 1982). The genus ovis tends to favour six wild species including, *O. orientalis*, *O. ammon*, *O.*

vignei, *O. canadensis*, *O. nivicola* and *O. dalli*. All domesticated sheep are now classed as *Ovis aries* (Wilson, 1991).

2.4. Sheep of Sudan (ecotypes)

African sheep included Sudanese sheep were classified by (Mason and Maule, 1960) in accordance to the tail shape into thin-tailed, fat-tailed and fat-rumped. Domestic sheep vary in size, shape of the body, nature of coat cover, productive ability, reproductive efficiency and adaptability to different environmental conditions. Sheep became a frontier industry in such areas as North America, Australia, New Zealand, and South Africa. It is only with the advent of refrigerated ocean-going ships in the last quarter of nineteenth century that the meat of sheep became important in international trade. Size and shape of appendages such as horn, tail, ears and profile, as well as many trademarks or special breed characteristics, were used in sheep classification. Numerous methods have been proposed and different systems were employed in classification of Sudanese sheep using different criteria which include production purpose, tail-shape, coat colour, origin, owning tribes and body weight (Devendra and Mcleory, 1982).

Mcleory (1961) classified Sudanese sheep in ecotypes associated with the owning tribes and their boundaries. The author suggested the term ecotype instead of breed because the sheep is not improved to be considered a breed. Sheep has been classified on the basis of morphology and distribution into: Sudan Desert and Sudan Arid Upland (McLeory, 1961; and Wilson, 1976). Sudan desert sheep owned mainly by nomads adapted to harsh environment and are considered the main export sheep of the Sudan (Elimam and Bashir, 2007). Sudan Desert sheep are further classified into tribal sub types, e.g., Hamari, Kabashi, in North and West Kordofan States, Shugor, Dubasi and *Watish* in the Central States (El-Hag *et al*., 2001).

- Sudan Desert Sheep: Within which several tribal types exist i.e. Kabashi, Hamari, *Watish*, Gezira, Butana, and North Riverain wooled sheep, Meidob and Beja.
- Sudan Nilotic Sheep: This sheep belongs to shiluk, Nuer, Dinka and related tribes of Nilotic and others who inhabit the flood plains of the Nile Rivers in Southern Sudan.
- Arid Upland Sheep: Owned by Zaghawa tribe of Darfur.
- Arid Equatorial Sheep: Owned by Toposa tribe, this inhabits the semi-arid region in Southeast Equatorial.
- West African Fulani: Um bororo: Is of little importance in the Sudan.
- Fused Ecotype Sudan Desert X Sudan Nilotic: Mostly bred by baggara and widely spread over the transition belt between Northern and Southern Sudan.
- Fused Ecotype, Sudan Desert X Arid Upland: Found in Northern Darfur.
- Fused Ecotype Sudan Nilotic X Arid Equatorial: This is found in southeast Equatorial.

Sudan Desert sheep are generally described as long-legged. The length of the legs is due to management and climate. In the Northern ranges where the scarcity of grazing imposes walking long distances, the sheep have developed longer legs and a light body. The sheep of the Southern regions (such as the Hamari variety), have shorter legs and heavy body, due to abundance of range grazing and drinking water, grazing distance is small and the seasonal migration range is comparatively short (El-Amin and Suleiman, 1983).

The locality and tribal origin of Desert sheep are identified in local markets by their colours. In the central and South-Eastern part of the irrigated Gezira and Rahad, the sheep population is dominated by the Dubasi variety. These carry a black patch on the back (saddle), the muzzle and legs. The rest of the coat is white with coarse hairy fibers. Further North

toward Khartoum, on the Eastern bank of the Blue Nile and the Nile, the Shugor variety predominates. These are uniformly yellowish brown. The Hamari variety in Southwestern Kordofan and South-Eastern Darfur are predominantly brown and dark brown. The Kabashi of Northern Kordofan and Northern Darfur, the Shambali of Eastern Kordofan, the Gash and Eastern Butana are all multi- coloured. The different colours of tribal varieties might have been brought about through prolonged selection toward colours preferred by particular groups or tribes because it is doubtful whether these experienced herdsman would have been aware of any possible relation between colour and productivity (El Amin and Suleiman, 1983). As the sheep fibers are utilized in nomadic home industry for weaving carpets and nomadic tents, the colour preference of the weaver might have played a vital role in this respect, (Wilson, 1981). Sudan desert sheep and its fusions comprise approximately 80% of all sheep in the Sudan (Devendra and Mcleory, 1982).

2.4.1 Kababish or Kabashi ecotype

Kababish sheep are known in North Kordofan as Burog with black and white colours, while in West Kordofan they are called Hur or Hamari which is mainly dark red (Ali, 2003).They include not only the sheep of Kababish tribe, but also Hamar, Kawahla, Benigrar, Howawir, Bediriya, Dar hamid, Hssaniya and Gawamaa. Collectively they include all the sheep of the tribes found throughout the area between the Nile and the Upland of Darfur and roughly North of Kosti-Nyala rail way line. This tribal breed of sheep is to be considered the model from which to discuss and compare with all other tribal breeds within this ecotype. These ecotypes are deep bodied, big, heavy boned, haired, good meat producer and excellent dairy animals (Devendra and Mcleory, 1982).

2.4.2 Hamari ecotype

Hamari breed of Desert sheep can be looked to be as protype of this ecotype. It is deep bodied, with strong heavy bones. Mature males are 70-80 cm. height at withers and weighed 60-80 kg, yet it is considered as a good animal for both meat and milk (Mcleary, 1961). Devendra and Mcleory (1982) mentioned that the Hamari sheep raised by Hamar tribe and other tribes like Gawamaa, Benigarar, Hawamda, Kawahala, Shanabla and Kababish, who inhabit the general expand plain in the center of country between the Nile and the uplands of Darfur States, specifically the areas of the El-nohod, Elobeid, Umrawba, ElKhewy, Abu Zabad and other area in Darfur States. The ewes are good milkers, the lactation period exceeds five months, and sexual maturity in both sexes is reached by 7 to 10 months. Castration of surplus males is common and many are carried to 18-24 months of age for marketing locally or for export. Dressing percentage varies from 47% to 50%. The coat colour is red. The strongest point of the Hamari breed includes high meat and milk production under harsh semi–desert condition both Hamari and Kababish breeds are the most famous for export and local consumption (Devendra and Mcleory, 1982).

2.4.3 Butana or Shukri ecotype

According to Mcleory (1961) they are found in Butana plains between the Atbara River and main Nile and Southward to Kassala-Gedarif railway line and they are smaller than Kababish and recorded height at withers was about 66-85 cm. Latter authors reported that, Butana sheep is characterized by polymorphism in colours include blond (35%), white with black spots (33%), red (15%), black (10%) and mixed black and white (5%). Generally it is difficult to distinguish between Butana and Gezira sheep included Shugor and Burog sheep and the average dressing percentage was 50% and daily milk production between 2.8 and 3.7 kg per day (Mcleory, 1961).

2.4.4 Shugor or Ashgar ecotype

Shugor sheep are found mainly in Butana plains, Gezira, and White Nile (Sulieman *et al*., 1990; Devendra and Mcleory, 1982). It is moderately large sheep, and the colour ranged between light and dark red and average body weight is 46 kg, age and weight at first lambing is 14months and 31.8–35.1kg respectively (Devendra and Mcleory, 1982). They are most common in the Western part of Gezira where they graze on cotton residues and other agricultural by-products. As compared to Kababish, Butana breed is more refined and somewhat deeper fleshed (Mcleory, 1961).

2.4.5 Dubasi or Burog ecotype:

Dubasi are the most dominant sheep of the Gezira area, especially the Northern part. Also called Masalami and Abusarig, the latter name was due to the black spot in the middle of the back, the name Dubasi referred to Dubasean tribe in Gezira, and they are similar in size to Shugor but their coarse coat is usually coloured white with black patches on the back "saddle" the muzzle, legs, ears, head and horns are similar to Kababish sheep (Devendra and Mc Leory, 1982).

2.4.6 Gezira or *Watish* ecotypes:

Watish subtype is somewhat smaller and stockier than either the Shugor or the Dubasi. Mcleory (1961) reported three colour groups fawn, red, and white with light spotting coloures. A high level of management under an extensive system of production permits *Watish* sheep to be the most productive type in the Sudan at such low latitude (11˚ to 13˚). They are hardy sheep and live under relatively high rainfall conditions between latitudes10° and 11°N and mainly along the Blue Nile, South of Wad Medani into the Fung area, they are mainly owned by nomadic and semi-nomadic tribes, including the Kenana, the Rufaa El Hoy and the Beni Meharib (Sulieman *et al.,* 1990).While Devendra and Mcleory (1982)

reported that, *Watish* sheep is found in the area between Sinnar and Elrank and considered as the best Desert sheep adapted to clay soil and high rains.

Watish has a solid white coat colour, other multi coloured coat is present either as white with red or white with black (Ibrahim, 2011). Sulieman *et al*. (1990) studied the mean of birth weight, weight at first conception, weight at first parturition, the weight at 120 days post the first parturition, and average daily weight gain for ewes from one to three years old were 3.1, 32.7kg, 34kg , 34.7kg and 16g per day respectively. The authors reported that, the average of reproductive parameters including litter size, lambing interval, annual reproductive rate were 1.17, 403 days and 1.14 respectively. Ibrahim (2011) stated that, *Watish* sheep have two seasons of breeding, the first season is controlled breeding known locally as (Bahla) and the other season is characterized by lambing throughout the year and this type requires high level of nutrition.

2.4.7 Meidob ecotype:

According to Devendra and Mcleory (1982) the name refers to Meidob Mountain in East Darfur and they are raised by Meidob tribes and they are similar to Kabashi sheep but smaller in size. Males are horned while females are polled. The author added that, their face profile is very convex like in Kabashi sheep and the coat colour is red, brown or grey, good for meat and milk production.

2.4.8 Garag ecotype:

Mcleory (1961) classified Garag as a subtype of Desert sheep. However, Khalifa (2002) suggested that Garag is probably a cross between Desert and Nilotic sheep in contact areas. Garag sheep is generally neglected and not preferred for meat production and the information on Garag sheep phenotype is scarce (Devendra and Mcleory, 1982).

2.5 Effects of Nutrition on production:

The productive and reproductive performance of sheep depends on many factors, especially genetic potential of a particular breed, availability of nutrition and environmental factors (Gbangboche *et al*., 2006; Bano *et al.*, 2011). Many authors showed that small ruminants fit well into arid and semi-arid ecological zones. The small size, low individual cost, rapid turnover, ability to adapt and the conversion of feed resources not eaten by man or other animal are distinct advantages of small ruminant husbandry (Eldaw, 2004). This large number of small ruminant has customarily been maintained on feedstuffs that come from four main sources; natural rage land grazing, which is of great importance across the majority of all ecological zones of the country, irrigated fodder crops, cereal grains and agro-industrial by-products.

Sheep are well known for feeding on a wide spectrum of plants, and said, to posses some degree of nutritional wisdom which enable them to select feeds that meet their nutritional needs and avoid those that causes toxicosis (Provenza *et al*., 1994). Optimal intake of nutrients by grazing sheep, however, could be easily achieved if we were able to understand and control their dietary habit and preference. Most animal feeds are from plants, it includes hay, straws, Silage, compressed and pellet feeds, and mixed rations. In small holder farming system, native forage and agricultural by-products are the main sources for ruminant feeds. Trees cover is developed in the hydromorphic zones and around brooks. These areas are accessible to animal during the rainy season but provide good pasture during the dry season and the beginning of the rainy season.

Agro-industrial by-products varied and constitute an important source of feeding-stuff for livestock; interest in their use has been stimulated by the emphasis on crop cultivation the increase volume of cultivation and more recently by the energy crisis. It is generally agreed

that inadequate nutrition is one of the main factors accounting for low sheep productivity in the country. The potential of any feed to support animal production depends on the quantity consumed by the animal and the extent to which the feed meets energy, protein, minerals and vitamins requirement (Minson, 1990). Nutrition is one of environmental cues that affect reproduction in domestic animals (Tatman *et al*., 1990). Direct effects of poor nutrition are reflected in reduced conception, embryonic losses, reduced lambing rate (Diskin and Nis-Wender, 1989) and high ewe mortality (Yoder *et al*., 1990). Low lambing rates represent a major obstacle to sheep production (Schoenian and Burfening, 1990).

The nutritional limitation, low nutritive value of the range, high ambient temperature, scarcity of feed and water are having great effects on the production of sheep. The most critical period for grazing sheep in the semi desert zone of Sudan is from February to June, when the ambient temperature becomes hot and range grazing is scanty and depleted of nutrients, seasonal nutritional status and husbandry affect sheep production characteristics (El-Hag *et al*., 2001).

2.6 Effects of Flushing on Reproduction:

It is widely accepted practice in sheep production to provide ewes with extra energy supply (Flushing) for 2-3 weeks prior to and during breeding for the purpose of increasing the number of lambs produced. Under harsher nutritional conditions in the arid Southern Mediterranean region where regular food supply is not guaranteed, lambing and twinning rate were shown to be boosted following nutritional flushing (Younis *et al*., 1978). Although experiments investigating this supplementation of the diet during mating have produce conflicting results (Rhind *et al*., 1989). It is evident that failure to flush ewes may result in delayed oestrus activity and ovulation (Gunn *et al*., 1979) fertilization failure (Restall *et al*., 1978) and embryonic mortality (Rhind *et al*., 1989).It is therefore inevitable for sheep

and sheep producers in the country to soonly resort for flushing systems and supplementation with trace minerals and vitamins to augment the poor range resources to meet requirements for sheep industry.

Rhind (1992) and Gunn (1983) suggested that ovulation rate depend on short term flushing only in ewes which are within the intermediate range of body condition. It is known that ovulation rate in ewes with moderate body weight condition increase on feeding above their energy requirements (flushing) during the few weeks before mating (Rhind *et al*., 1997). Several studies have been conducted to improve both nutrients utilization and energy availability during this period using different feed supplementation from synthetic or natural sources (Wang *et al*., 2009; El-shahat and Amu, 2011; Khajali and Shorifi, 2018). The ability of nutrition around the time of mating to alter ovulation and lambing rate of ewes in many breeds is well known (Ocallaghn and Boland, 1999). Working with a British breed, (Rehind *et al*., 1989) stated that low feed intake before mating reduced the mean ovulation rate and low intake after mating induced a higher rate of ova wastage.

2.7 Effects of Nutrition, Flushing and supplementation on the following:

2.7.1 On breeding season, mating and ovulation:

Sudan desert sheep can mate throughout the year, and in North Kordofan they are raised under open rangelands. Never the less, defining breeding season is common among sheep producers. The breeding season is usually planned for January – March to match lambing with the wet season and therefore, more, nutritious grazing (Mukhtar, 1985). However, mating coincides with the dry season (February – June) when rangelands are at their lowest nutritional quality (El-Hag, 1992).

Sudanese sheep are not seasonal breeders and may have lambs throughout the year. Many local breeders, however, have attempted to establish two main breeding seasons, one during the wheat and cotton harvest in the Winter and the other during the rainy season, nutritional conditions at those periods provide natural flushing. There are therefore two lambing seasons, in Summer (July-August), when the majority of flocks lamb, and in winter (December-January). Because of the soaring cost of living and of keeping sheep, some breeders are now turning to more intensified rearing so that lambs are available at all periods of the year. To achieve this, they spend more money on supplementary feed and allow rams to run freely with recently lambed ewes. The general policy at El Huda National Sheep Research Station was to maintain purebred flocks, except for very limited inter-flock breeding in 1978 and 1979. The usual practice at the station was to carry out Summer and Autumn mating to produce Autumn and Winter lambs crops. Most parturition occurred from July through December (Suliman, *et al*., 1990).

2.7.2 On estrus cycle:

Other feature of the reproductive function, such as the onset of puberty (Kassem *et al*., 1989) or the responses to the ram effect (Hamidallah *et al*., 2000; Thimonier *et al*., 2000), can also be modified through short to medium term dietary changes.

When the nutrient requirements for ewes are not met, supplementation might be an effective strategy to minimize ewe weight loss as well as to increase lamb growth (Rosales *et al*., 2016). Weekly injection of 900 i.u. of vitamin E to ewes in late gestation did not affect lambs birth weight, but increased the pre-weaning weight and daily weight gain while supplementation of Se at 90ppm to ewes in late gestation and during lactation significantly increased birth weight (3.69º/only) (Ali *et al*., 2004).

The extra nutrition or flushing did not influence the interval to the onset of estrus and duration of ewes. Flushing of ewes prior to supplementation with additional concentrate did not increase the ovulation rate in agreement with (McEvoy *et al*., 1995).

2.7.3 On lamb mortality

Ndamukong (1985) reported that, lamb mortality accounts for serious losses in sheep production and is thus a major factor reducing profitability of sheep farming. Predisposing factors affecting lamb mortality include; diseases, breed type, age of lamb, litter size, season of birth, nutrition, birth weight, management, and parity of the ewe (Ibrahim, 1998). Animals born as twins have much higher death rates than those born as single mainly due to lower birth weights and lower milk availability per lamb and the majority of lamb mortality occurs within seven days of birth (Gatenby *et al.*, 1997). The latter author added that, lamb mortality is higher for lambs born from younger ewes than those born from older dams. Abdalrazig (2005) studied 331, 262, 416 and 308 lambs of the Shugor, Dubasi, *Watish* and Kabashi subtypes of Desert sheep respectively and reported that, mortality rates ranged from 13.7% for *Watish* lambs to 17.2% for the Dubasi lambs. A comparable mortality rate of 18.2 to 21.5% was reported by El-Hag *et al.* (2001) for Desert sheep in North Kordofan and Darfur, and relatively higher rate of 23.0% was found by Wilson (1976) for Desert lambs in South Darfur.

2.7.4 On Fertility:

Nutrition influences ruminant fertility directly by the supply of specific nutrients required for the processes of oocyte and spermatozoa development, ovulation, fertilization, embryo-survival and establishment of pregnancy, through its impact on circulating concentrations of the hormones and other nutrients that are required for success of these processes. Current research on nutrition and ruminant fertility extends

from whole animal responses to intricate cellular and molecular events that control gamete production, embryo development, conceptus growth and implantation. It also deals with the effects during embryonic and faetal life on the timing of puberty and subsequent adult fertility.

A further dimension to recent nutritional research on ruminant fertility is the identification of feeding strategies that improve the cryopreservation qualities of the spermatozoa in male and super-ovulation response and embryo qualities in female, involved in multi-ovulation and embryo transfer progamme. Direct effects of poor nutrition are reflected in reduced conception, embryonic losses reduced lambing (Diskin and Niswender, 1989) and high ewe mortality (Yoder *et al*., 1990). Low lambing rates represent a major obstacle to sheep production (Schoenian and Burfening, 1990). Low lambing rates of 64-70% have been reported for sheep in Sudan (Muktar, 1985).

During the last few weeks of gestation the most apparent characteristic is the reduction in feed intake through extensive metabolic and physiological changes surrounding parturition, accompanied with high nutrients demand to fulfill the requirements of the developing conceptus and onset of lactogenesis (Abuelo *et al*., 2019).Such changes are associated with high occurrence of negative energy balance and increasing susceptibility to metabolic and infectious disease (Hashem and Elzarkouny, 2017). Several studies have been conducted to improve both nutrients utilization and energy availability during this period using deferent feed supplement from synthetic or natural sources (Wang *et al*., 2009; El-shahat and. Amu, 2011; khajali and Shorifi, 2018).

When reviewing nutritional effects on fertility in small ruminants, Landou and Molle (1997) concluded that for several Mediterranean breeds of sheep a short-term feed supplementation before mating positively influenced ovulation. Gunn (1983) suggested that ovulation rate is

dependent on short flushing only in ewes which are within the intermediate range of body condition. (Molle *et al*.,1994) reported that relatively low amounts of Soyabeen meal (250g per ewe per day) may increase ovulation rate in grazing Sarda ewes in June – July when flushing begins 14days before ram introduction.

2.7.5 On lambing rate:

The differences obtained between the various classes at 1 year of age may be more of a reflection of the ewes' fertility, than that at the second lambing may be more of a reflection of prolificacy (lambs born/ewe lambing). The fact that the estimate of repeatability at the first lambing at 1 year of age was higher than that at the second one, the first lambing is a much better predictor of a ewes' inherent reproductive potential and suggests that sheep-men can effectively select for reproductive rate on the basis of this measurement (Dzakuma, *et al* 1982).

2.7.6 On Litter size:

Litter size is largely determined by ovulation rate but is also modified by fertilization rate and embryonic and fetal losses, also other influencing factors are breed, level of nutrition, season and age of ewes. litter size varies between 1.08 and 1.75 with the average of 1.38 for tropical breeds (Girma, 2008). Solomon *et al*. (2010) reported that, litter size of Ethiopian Washera sheep breed was about 1.11. According to Sulieman *et al.* (1990) who stated that litter size of Shugor, Dubasi and *Watish* were about 1.30, 1.18 and 1.17 respectively. Wilson (1981) stated that, it was ranging between 1.05–1.2 for *Watish* sheep. Sulieman and Eissawi (1984) reported that Shugor had more litters (1.25) than either Dubasi (1.16) or *Watish* (1.16) although the differences between groups were not significant. El-Karim and Owen, (1987) showed that Shugor had significantly more litters (1.25) than *Watish* (1.13).

2.7.7 Annual reproductive rate:

Annual reproductive rate is defined as litter size times 365 days divided by lambing interval in days, or number of lambs born per ewe per year (Agyemang *et al*., 1985; Sulieman *et al*., 1990; Ibrahim, 1998). According to Gautsch (1987) the annual reproductive rate of African sheep varied from 1.10 to 1.36, and it was affected by the year and season of lambing; being highest during the small rainy season and lowest when lambing occurred during the dry season; The author attributed this difference to the fact that ewes that lambed during the dry season had longer subsequent lambing interval than those that lambed during the rainy season. Annual reproductive rate is a composite parameter that combines key influences on small ruminant productivity i.e., litter size, pre-weaning mortality and lambing intervals and it is described by the following relationship: ARR= (S (1- M)\ L; where ARR is annual reproductive rate, S is the litter size, M is the rate of pre weaning mortality and L the lambing interval in years (Ibrahim, 1998; Wilson 1989) highly recommended the use of this parameter as it allows for easier comparison of sheep productivity between different systems and easily highlights changes in climate and stated that, high annual reproductive rate is an indication of shorter lambing intervals, low mortality and a high litter size and hence, high productivity. Sheep breeding under range conditions in Sudan is controlled to a single crop delivered during the rainy season, but the ewe can give three crops every two years when feed is available, and this might greatly influence annual reproductive rate (Babiker, 1989).

Sulieman *et al*. (1990) reported, that the annual reproductive rate of Dubasi, Shugor and *Watish* ewes were 1.01, 1.18 and 1.14 lambs per ewe per year respectively. The *Watish* did not differ significantly from the Dubasi in annual lamb output but the Shugor was clearly superior to the Dubasi, producing on average, 0.17 more lambs per year.

2.7.9 On birth weight:

Heavy birth weight provides lambs a good start in life and rapid growth in the pre- and post weaning periods and ensures resistance to disease as well as early maturity, Winter-born lambs were heavier than lambs born during the hot summer and lambs born in the wet summer were heavier than those born in either of the other two seasons, (Sulieman *et al.*, 1990; Koney, 2004) defined birth weight as the weight of the newly born animal before it takes in milk and the importance of optimum birth weight in lambs is based on the evidence that high birth weights is negatively correlated with lamb mortality. Steinheim *et al*. (2002) found that low birth weight of female lambs subsequently affected the birth weights and number of lambs they produce later in life. Moreover, low birth weights were reported to have an impact on the health of the animal, including negative consequences for the reproductive ability of the animal which persist throughout its life.

Sulieman *et al.* (1990) reported that, birth weights of Sudan Desert sheep at EI-Huda research station included Shugor, Dubasi and *Watish* subtypes were ranging from 2.5 kg to 4.2 kg. The author added that, birth weight was significantly affected by birth types, season, and parity. Other workers completely agreed with former author (El-Amin and Rizgalla, 1976; Wilson, 1976; El-Hag *et al.*, 2001). Abdelrazig (2005) stated that Shugor sheep had the highest weight at birth followed by Dubasi and *Watish* , while Kabashi subtype recorded the lowest weight at birth and the birth weight of these four subtypes were 3.63±0.06, 3.43±0.05, 3.17±0.04 and 2.90±0.06kg respectively.

2.7.10 On growth rate:

Animal growth can be defined as an increase in body weight that is achieved by both hypertrophy and hyperplasia until a mature size is reached and the development of an animal can be defined as changes in

body conformation and form until maturity is reached (Lawrie, 1998). The sigmoidal growth curve (S-shape curve), relating live weight to age is recognized by three distinct phases, starting with a slow growth phase, where an increase in age is accompanied by a small increase in live weight, followed by a rapid growth phase, and ending with a plateau phase where the growth of muscles, bones and vital organs has slowed down and fattening accelerates (Lawrie, 1998). The order of tissue maturation is bone, followed by muscle and then fat (Rouse *et al*., 1970).

2.7.11 On pre-weaning weight:

Live weight and growth rate of lambs are economically critical features, requiring particular attention in any breeding programme intended to improve overall productivity since lambs are mainly raised for mutton (Tibbo, 2006). A slow growth rate, resulting in a low market weight of indigenous sheep, as an important limiting factor on profitability of sheep, has been documented in the Ethiopian highlands (Mukasa-Mugerwa *et al*., 1994). Early growth is influenced by several factors such as the genes of the individual for growth, the environment provided by the dam, sex of lamb, litter size and season of birth (Abegaz *et al.*, 2005). Genetic improvement could be one way to improve growth in the indigenous sheep breeds (Tibbo, 2006). Sulieman *et al*. (1990) studied the pre weaning growth rate in Dubasi, Shugor and *Watish* subtypes at Elhuda research station. The authors reported that, growth rates from birth to 30 days neither differ among subtypes, nor they were influenced by dam origin; but they were influenced by all the other sources of variation tested (sex of lamb, season of birth, year of birth and parity), whereas, from 30 to 120 days there were differences in growth rates among genotypes, between sexes, between single and twin lambs and among lambs born in different seasons and different years. The authors added that, average daily gain of *Watish* lambs were 125g, 91g and 99g for the periods 0-30 days, 30-120 days and 0-120 days after, birth, respectively.

2.8 Effect of vitamins and minerals supplementation on reproduction

Reproductive performance of farm animals depends on adequate balanced levels of vitamins and essential minerals due to their important roles in cellular metabolism, maintenance and growth (Gutteridge *et al*.,

1994). Also, these nutrients have specific roles and requirements in reproductive tissues (Kolb *et al*., 1997).Vitamins and minerals play an important role in the growth of animals and their reproductive performance. The mineral balance should be considered when feeding goats or sheep with alternative feed resources, because dietary deficiency in particular minerals can be detrimental to the reproductive function of both males and females.

Some natural forage contains high levels of specific trace elements, for example vitamin E in saltbush (Norman *et al*., 2004) and selenium in Astragalus plants (Pickering *et al*., 2003), can be used to compensate the deficiency of some native pastures. However, grazing Astralagus species can reduce productive system, but have the potential to affect hormonal systems that link energy.

2.8.1 Effects of vitamin E on reproduction:

Vitamin E occurs naturally in young grass and products of plants origin but decrease during storage. Vitamin E works as important biological antioxidant for damage created by free radicals. There are several forms of vitamin E where Tocopherol is the most biologically active form as an antioxidant vitamin E, protect poly-unsaturated fatty acids (PUFAs)from oxidation and especially important for neonates who have a greater sensitivity for oxidation damage (Debier *et al*., 2005).

Vitamin E is a very important antioxidant, it has an irreplaceable function in protecting the body against free oxygen radicals which can lead to DNA damage and inhibit mutagens in the gastrointestinal tract. It is also a factor that slows down the aging of the body and plays a role in the prevention of cardiovascular disease and cancer (Eitenmiller and Junsoo 2004). The antioxidant action of vitamin E is also significant to the genetic material stability because autoxidation products of lipids and unsaturated fatty acids are highly toxic mutagenic substances (Vaca *et al*., 1988).

The health status and efficiency of growth and production could be increased by supplementation of vitamin E in sheep (Ali *et al*., 2004). The recommended daily doses of vitamin E are from 10 mg to 15 mg for adult and 1mg to 8 mg for children (Monsen, 2000). On the other hand crops, cereal grains and dry hay tends to be poor source of vitamin E contents and prolong storage of foodstuff resulted in degradation of vitamin E content.

Vitamin E deficiency is often associated with disorder of fat absorption or distribution of cystic fibrosis (Wilkinson *et al*., 2010). Some literature cited a variety of deficiency symptoms including a decrease in growth rate, lowered immune system and finally increased susceptibility to secondary infections (Blowey, 1993). Many *in vitro* and *in vivo* studies have indicated a relationship between Vitamin E supplementation and reduced risk of cancer (Albanes *et al*., 2000 and Kune and Watson, 2006) and DNA damage (Mozdarani and Salimi, 2006 and Lorenzetti *et al*., 2007).The health status and efficiency of growth and production could be increased by supplementation of vitamin E in sheep (Ali *et al*., 2004). It has been found that the performance of phagocytosis can be improved by selenium and vitamin E injections (Gyang *et al*,. 1984).

When the nutrient requirements for ewes are not met, supplementation might be an effective strategy to minimize ewe weight loss as well as to increase lamb growth (Rosales Nieto *et al*., 2016). Chauhan *et al*. (2016) reported that lamb's dietary supplementation with supra-nutritional levels of Se and vit. E during the 3weeks finishing period improved average Dry matter intake and average daily gain. Reo *et al.* (2010) observed a significant decrease in faecal egg counts for lambs experimentally infected with haemonchus contortus but supplemented with Se and vit.E, such effect on resistance for parasite could be due to stimulation of the lamb's immune system (Hamam and Abou-Zeina, 2007).

It has been found that the performance of phygocytosis can be improved by Se and vit.E injection (Gyang *et al*., 1984).

2.8.2 Effects of Selenium on reproduction:

Imbalances in trace minerals many occur in farm animals, especially ruminants, whose intake of minerals depends largely on the content in the forage and thereby on the soil where the lay grows. Selenium is an important trace element that has a narrow range between deficiency and toxicity in sheep (Humam-Ziehanka *et al*., 2013). Selenium is an essential micronutrient in animals (Klasing, 1998; Elisler, 2000) and it has three levels of biological activity, Trace concentrations are required for normal growth and development, moderate concentrations can be stored and homeostatic functions maintained and elevated concentrations can result in toxic effects.

It is widely documented that Se has an influences on reproduction in animals and that Se. deficiency can reduce reproductive efficiency and growth as well as general health in young animals (Ghany- Hefnawy *et al*., 2008). Se is necessary for growth and fertility in animals and prevention of variety of disease condition (Kolodzie *et al*., 2005; Marai *et al*., 2009). Animals that mainly consume home produced roughages therefore easily can suffer from Se. deficiency if they are not supplemented in appropriate way.

Selenium (Se) is an integral component of the enzyme glutathione peroxidase (GSH-Px) an enzyme involved in detoxification of hydrogen peroxide and lipid hydroperoxide, Physiological functions of this enzyme have been yet precisely determined. Between the GSH-Px activity in seminal plasma and semen quality not found a clear relationship (Lasota, 2002). This enzyme detoxifies lipid peroxides and provides protection of cellular and sub cellular membranes against peroxide damage. Thus, the mutual sparing effect of selenium and vitamin E stems from their shared

antiperoxidant roles (Krska *et al*., 2001). GSH-Px is present, both in a number of tissues and in the body fluids. Its high activity has been observed both in the organs of the reproductive system and in the fluids secreted thereby (Saaranen *et al*., 1979). GSH-Px existing in seminal plasma is probably first of all synthetised in accessory sexual glands, whereas activity of this enzyme in mature sperm is low (Smith *et al*., 1979).

Selenium is a source of micro-element mineral supplement added in rations. It is a substance required by animal in very small amounts for regulating various body processes toward normal health, growth, production and reproduction (Varly, 1967). From a nutritional point of view, the inorganic forms of selenite and organic forms selenomethionine and selenocysteine might be the most important chemical forms of selenium, (Varly, 1967). In selenoamino acids, the Sulphur of the corresponding Sulphur containing amino acids is simply replaced by selenium during synthesis (Ndibualonji, *et al*., 1997), whereas most plant – and animals- derived their feed and food from natural sources contain organic forms of selenium, e.g. selenoamino acids. The inorganic selenium salts are commonly used for supplementation of livestock rations as cheap and efficient means to prevent selenium deficiency, (Varly, 1967). However, during recent years organic forms of selenium in the form of selenium en-riched yeast have become available to farmers. It has been assumed that in yeasts cultured in high- selenium medium the most abundant chemical form of selenium may be selenomethionine. However, recent findings with improved analytical methods indicated that a wide variety of seleno compound, many of which are unidentified, are present in selenium yeast (Awadch, *et al*., 1998). Thus the selenium yeast actually contains a cocktail of selenium in a variety of chemical forms. It should be further mentioned in this content, that the specific chemical forms of

selenium in most food and feed are unknown. According to Seboussi, *et al*. (2009) previous comparative studies, it appears that different livestock species show different metabolic profiles of serum Se. levels and glutchione perioxide (GSH-px) activity.

Selenium is also associated with thyroxin, a thyroid hormone that regulates metabolism, reproduction, circulation and muscle functions. Selenium is highly toxic if excess amounts are consumed. Unfortunately, the amount of selenium required is very close to the toxicity level, thus great care must be taken. Selenium also protects the body from heavy metals by forming complexes to render their harmless (Lemly, 2002). Selenium deficiency occurs mainly in young categories of farm animals and high performing animals (Kursa, 1969; Pavlata *et al.*, 2001). In majority of the production herds of farm animals generally Se supplementation is a condition for maintaining their health (Pavlata, *et al*., 2004), and sufficient amount of Se. in animal products (Travnicek *et al*., 2006).

Serious Se deficiency can lead to nutritional muscular dystrophy (NMD) also called white muscle Disease, the subclinical symptoms such as weak lambs, reduced feed consumption and pregnancy complications (NRC, 2007). Marginal Selenium deficiencies can result in impaired fertility, silent heats, cystic ovaries and the birth of unthrifty kids with poor immunity. Se supplementation to the diet of animals could eliminate certain types of stresses such as heat stress or postpartum stress (Herbut and Angrecka (2015) and resulted in increasing Se concentration in colostrums of goats (Kachuee *et al*., 2014; Horky *et al*.,2017) and in ewes (Moeini and Jalilian 2014; Erdogan *et al*., 2017).

Several studies have determined that injection of supplemental Se solution increased serum and tissue concentration of the element and serum or plasma Se concentrations provide a good indication of Se status

in ruminants (Pastrana *et al*., 1991; Andres *et al*., 1996).The concentration of Se in animals is dependent on its intake with food (Surai, 2006).

Pilarczyk *et al*., (2004) found a significant improvement in reproduction indices (fertility 96% and fecundity 137.5%) after application of sodium selenite in ewes. Administration of Se improves daily weight gain in lambs (Gabryszuk and klewiec, 2002) and reproductive performance in ewes. Se deficiencies in sheep in Newzealand and Australia were the cause of 20-50% of infertility in females and also an increase in lamb losses was observed (Suttle 2010; Ren *et al*, 2011). These authors showed that Se deficiency also negatively affect rams (The numbers of sperm in ejaculate, sperm concentration and motility), fetal death may also occur in pregnant ewes as well as placenta retention after birth (Ren *et al*., 2011).

McDowell *et al*., (1996) reported that Selenium deficiency plays serious numerous economically important livestock diseases, problems that include impaired fertility, abortion, retained placenta and neonatal weakness. Moreover, Se is component of selenoproteins and involved in immune and neuropsychological function in the nutrition of animal (Meschy, 2000). Gabryszuk and Klewice (2002) reported that the administration of Se improved daily weight gain in lambs. Many researchers reported that Se is necessary for growth and fertility in animals and prevention of variety of disease condition (Kolodziej and Jacyno, 2004; and Balicka-Ramisz *et al*., (2006).

Pilarezyk *et al*., (2013) reported that the reproduction indices (fertility and fecundily) were improved as result of the application of Se yeast. According to authors, lamb losses in the experimental groups were lower (9.3%) than in control group (12.3%). Death in the group of lambs' derived from ewes fed Se yeast were significantly lower, body weight of lambs on the day of birth was higher, the number of live born lambs

derived from mothers that were administrated Se yeast had significantly higher body weight at 33 and 90 day of age compared to lambs of mother not receiving Se reproduction indicates (fertility and fecundity) were also improved as a result of application of Se yeast in ewes. Segerson *et al*. (1986) reported that the number of lambs born alive from control Se treated ewes was 1.61 and 1.81, respectively, while the number of lambs weaned per ewe was 1.1 and 1.5, respectively. Fatal death may also occur in pregnant ewes as well as placenta retention after birth (Ren *et al*., 2011).

Se serum or blood level can be an indicator of the supply of (intravitally) as well as its content in the liver and in the kidneys. Puls (1994) points that the concentration of Se in the liver is a better indicator of Se level than the kidney test. Mahan and Kim (1996) believed that the assessment of Se status of organism should involve blood or serum test. The most common used criterion for assessing the Se status in livestock is the serum or blood contents. According to Grase (1997), the biological standard used in the diagnosis of serum Se deficiency in ruminants was: less than 0.41g ml^{-1}, 0.41-0.079 ml^{-1} Physiological level.

Several studies have determined that injections of supplemental Se solution increased serum and tissues concentration of the element and serum and plasma. Se concentration provides a good indication of Se status in ruminants (Pastrana *et al*., 1991; Andras *et al*., 1996).

2.8.3 Combine effect of Selenium and Vit.E on Reproduction:

Se and vitamin E have a close relationship with each other (Moeini *et al*., 2011). They exert similar effects on cell via independent biochemical pathway and in different locations (Hamam and Abou-Zeina, 2007).

As antioxidant vit.E (α tocopherol) and Se have complementary rote in protecting the cell against damaging effect of lipids pexoxide and free radicals produced during normal metabolism. Both vit.E and Se have been

shown to improve immune responses (Shinde *et al*., 2007). The multiple functions of both nutrients at cellular and molecular levels, extend beyond antioxidant protection and their inclusion in the diet at concentration above requirements is associated with variable improvements in sheep performance and immune function (Rooke *et al*., 2004; Hamam *et al*., 2007; Mohanta *et al*., 2015).

Vitamin E and Se diet improve the physiological hormonal antioxidant status of supplemental sheep (Shakirulla *et al*., 2017), and had ameliorative potential against toxic effects of arenic (Roy and Roy 2017). In livestock dietary supplementation with vit.E and Se may improve the negative effect of heat stress and restore the redoes haemostasis in different breed of sheep (Shah *et al*., 2016).

Consequently a great attenuation has recently been focused on the role of vit E and Se in protecting leukocytes and macrophages during phagocytosis. It has been found that the performance of phagocytosis can be improved with selenium and vitamin E injection (Gyang *et al*., 1984). Se has biological functions related to vit. E in that Se is an essential component of glutathione peroxidase, an enzyme involved in detoxification of hydrogen peroxide and lipid hydroperoxides. Dietary Se and vit E injections to ewes in late gestation and during lactation improved performance and livability of lambs (Ali *et al*., 2004). Injection of vitamin E plus Se to ewes at 4weeks late and during suckling period for 12 weeks significantly improved average body weight and daily weight growth of off-spring from birth up to weaning (Soliman *et al*., 2012).

2.9 Haematology:

2.10.1 The Blood:

Blood is a unique fluid, containing cells, that is pumped by the heart around the body of animals in a system of tubes known as the circulatory

system. It serves as a transport medium (Melvin and Reece, 1993).The liquid portion of blood is referred to as plasma if the blood was not allowed to clot, and serum, if it was the liquid portion without the cells is generally straw or light yellow color; this portion of the blood is used in the chemistry tests, (Melvin and Reece, 1993).

2.9.2 Functions of blood:

Blood has many important functions such as:-

-Nutritional function:-

It carries nutrients from the digestive tract to the tissues.

-Respiratory function:-

It carries oxygen from the lungs to the tissues, carbon dioxide from the tissues to the lungs.

-Excretory function:-

It carries the end products of metabolism from the cells to the site of their excretion.

-Regulatory function:-

Blood also helps regulate body temperature and regulate the body hydrogen ion concentration.

-Defense function:-

It has as important role in defending the body against diseases.

-maintains a constant concentration of the water and electrolytes in the cells (Melvin and Reece 1993).

-The circulating blood accounts for 5-7% of the total body weight and is composed of two major elements.

2.9.3 General physiology and environmental influences of normal haematology:

Exercise and emotional state are important variables to be considered when establishing reference value in domestic ruminants.

Despite the range and sensitivity of technology used, cattle, sheep and goats blood reference values are uniformly broad (Jain, 1986). Domestic cattle, sheep and goats have little or no direct physical contact with humans; therefore, when sampling occurs the animals must be physically restrained and become emotionally upset. Reports of reference value include such variables as exact age, emotional state, history, form of restraint, ambient temperature and state of hydration or parasite burdens (Bernard *et al.*, 2000). The numerous reference values for domestic cattle, sheep and goats have been reported and reveal few haematological breed differences. Breed differences have been reported for beef cattle, which have greater red blood cell (RBC) value than dairy cattle breeds as well as sheep with different haemoglobin and goats with differing cell shapes (Bernard *et al.*, 2000).

Seasonal, environmental changes influence blood values. In all species, differing oxygen tensions of altitude, the lower the oxygen tension and the higher the erythrons reference ranges.

2.10 Haematological parameters blood components:

2.10.1 Haemoglobin concentration:

Studies of haemoglobin's tetrameric peptides A and B chains are the foundations of population and molecular genetics. Ruminant haemoglobin is of particular interest because of the large amounts of polymorphism, which occurs between species, breeds and within the individuals as it develops from embryo to adult (Kitchen., *et al* 1974). The polymorphism is greatest in the B chain. As in many other species, ruminants have two haemoglobin types; Embryonic type (HbE) to maintain a dam to urea O_2 gradient and adult type (HbA) for the ex utero environment. Transition from HbE to HbA begins in utero and not be complete until months after birth. Like humans, cattle, sheep and goats have third haemoglobin, fetal

haemoglobin (HbF), which replaces HbE in utero. As gestation progresses to the prenatal period, bovine HbF is gradually replaced by HbA. As the prenatal RBCs live out lives, HbF containing cells give way to HbA containing RBCs (Bernard *et al.*, 2000).

Sheep and goats have a unique fourth haemoglobin type, HbC. The HbC replaces HbF at birth; within a few months, HbA replaces it. Although HbC and HbA have the same O_2 affinities at arterial pO_2, HbC,s O_2 affinity is lower than HbA in the hypercapnic, hypoxic peripheral environment Wilson (1989). A unique feature of HbC and HbA of sheep and goats that is absent in HbE or HbF is the ability to switch HbA on off by erythropoietin (Barker *et al*., 1980).

2.10.2 Red blood cells (Erythrocytes):

Erythropoietin (EPO) control of erythropioieses is well established, and a recombinant commercial human EPO is available. Because of EPO,s highly conserved structure across species lines, sheep are the subject of experimental studies of EPO,s control of erythropoieses (Wen *et al*., 1993). A unique feature of EPO is its direct control of the HbA to HbC shift (Barker *et al.*, 1980).

During gestation and birth, the haemoglobin types change and the erythrons size increase. At birth about 60-90% of the neonatal calf's Hb is HbF and 9% of the RBCs reticulocytes. Fetal calves RBCs are less fragile and larger than the adult bovine's RBCs. In early gestation, the bovine fetal RBCs have a mean corpuscular volume (MCV) of approximately 95 fl, but at birth it has decreased to about 46 fl, From birth to about 8 to 12 weeks of age, the MCV continues to decrease to approximately 37 fl as the populations of HbF RBCs are replaced by RBCs containing HbA (Bernard *et al.*, 2000).

2.10.3 White blood cells (Leukocytes)

Cell sorting by immune cell structure markers has improved specificity and sensitivity of cell counting (Naessens *et al.,* 1996). The B lymphocytes paracrine dependency or the T lymphocytes is an example of the dynamic natural history of the cell. In the first few weeks of life, neutrophils are the dominant WBC in the calves, kids and lambs. By about 2 weeks of age, the lymphocytes decrease has become the dominant WBC, with neutrophils to lymphocyte ratio of 0.5 in calves and lambs and 0.6 in kids. As bovine adults age, the concentration of neutrophils and lymphocytes continue to be the dominant cell (Bernard *et al*., 2000).

2.10.4 Packed Cell Volume (PCV)

The PCV is expressed as a percentage volume of packed cells of the whole blood after centrifugation. The volume of cells in the circulating blood is usually less than plasma volume. Most species of domestic animals have PCV volume of 38 – 45 percent with a mean of 40%. Haemoglobin concentration due to dehydrate, asphyxia or excitement leads to release of erythrocytes from the spleen resulting in abnormally high PCV value (Dukes, 1993).

2.11 Blood Biochemical Parameters serum blood component:

2.11.1 Total protein:

The total protein test measures the total amount of two classes of proteins found in the fluid portion the blood albumin that helps prevent fluid from leaking out of blood vessels and carried chemicals to the blood and globulin that immune the body system (Manary., 2020).

2.11.2 Serum albumin:

Albumin produced only in the liver, is the major plasma protein that circulates in the blood stream. Albumin is essential for maintaining the oncotic pressure in the vascular system. A decrease in oncotic pressure due

to a low albumin level allows fluid to leak out from the interstitial spaces into the peritoneal cavity producing scales. Albumin is also very important in the transportation of many substances such as drugs, lipids, hormones, and toxins that are bound to albumin in the blood stream. Once the drug or other substance reaches the liver, it is detached from the albumin and made less toxic by conversion to a water–soluble form that can be excreted (Pagana, 2002; Fischbach *et al.*, 2004).

A low serum albumin indicates poor liver function. Decreased serum albumin levels are not seen in acute liver failure because it takes several weeks of impaired albumin production before the serum albumin level drops. The most common reason for a low albumin is chronic liver failure caused by cirrhosis (Pagana, 2002; Fischbach *et al.*, 2004).

Albumin levels can be low in conditions other than liver disease, such as severe malnutrition and some kidney diseases that cause extensive protein wasting. A loss of albumin in the urine caused by renal dysfunction (nephritic syndrome) can cause a decrease in the serum albumin.

When there is inadequate protein intake, the body begins to breakdown muscle to obtain enough amino acids for the synthesis of serum albumin. Albumin levels do not drop in fasting states or in malnutrition until the condition is severe. There are no pathological conditions that cause the liver to produce extra albumin; thus; an increased rate is a reflection of dehydration (Pagana, 2002; Fischbach *et al*., 2004).

2.11.3 Serum glucose:

Blood glucose sources in ruminants are derived principally from gluconeogenic amino acids (Heitman *et al*., 1973), propionate, lactic acid, and to a lesser extent butyric acid (Coles, 1967). Propionate derived from rumen fermentation is considered to be the major gluconeogenic precursor in fed ruminants (Young *et al*., 1965). The liver and to a lesser extent the kidneys, are the only endogenous sources of blood glucose. Ruminants

absorb little glucose from the digestive tract because of extensive degradation of dietary carbohydrates to VFA in the rumen (Clark, 1975). There are essentially no glucose absorption from the gastrointestinal tract (G.I.T) of mature ruminants and depend almost entirely on glucoeogenesis. Although glucose absorption from the gut of ruminants are increased when high concentrate diets are fed (Armstrong and Bever, 1969).

2.11.4 Serum Cholesterol:

Cholesterol is a sterol that is present in all animal tissues. Free cholesterol is an integral component of cell membranes and serves as a precursor for steroid hormones such as estrogens, testosterone, and aldosterone, as well as bile acids (Panel *et al.*, 2005). Cholesterol in the plasma occurs in a free as well as in esterified form. The liver plays a dominant role in the homeostasis of serum cholesterol levels (Coles, 1967). Numerous factors have been reported to affect blood cholesterol level such as, nutrients, age, feeding period, starvation, lactation, season, rate of gain, thyroid status and management Park *et al.*, (1980), found that concentrations of free cholesterol were higher ($P \leq 0.05$) for heifers on the low protein (28.2mg/100ml) as compared to the high protein group (17.9 mg/100ml).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental site:

This study was carried out at the Extension and Rural Development Centre (ERDC), Faculty of Animal Production, University of Gezira (Elmanagil town). Elmanagil town is located in the center of Gezira agricultural scheme 76 kilometres west Wad Medani, Gezira State, Sudan. The area lies between latitudes 13.30 and 14.45 N longitude 32.45 and 33.15 E approximately in the center of Sudan.

The area described as vast plains with heavy clay soils, with the largest agricultural scheme in the world. The scheme is an irrigated agricultural scheme from Blue Nile River by passive gravity surface irrigation and water canals are filled with water approximately all the year round. Crops cultivated in the scheme are mainly Cotton, Groundnut, Sorghum, Sunflower and legumes. Recently livestock were introduced in the crop rotation in the scheme with the main objective of energy adequate feeds for livestock.

3.2 Climate:

The climate of Gezira state varies from poor Savanna climate in the Northern part to rich woodland savanna in the Southern part of the state. The climate is generally dry and hot during Summer (March-June), warm and hot during the rainy season (July-October), moderately cool during Winter (November-February) (Anon-2018). The highest and lowest average temperatures were recorded from Meteorological station in ERDC, and it was found to be 29.5, 34.5, 37.0, 32.5 and 32.5c^{o} for March, April, May, June and July, respectively. The timing and duration of the trial was intentionally selected to represent the Summer-dry season where the animals in the Sudan

under pasture and range conditions suffer from drought and lack of feed. The site of the trial is described as vast plains with heavy clay soils, with one of the largest agricultural schemes under irrigation in the world.

3.3 Rain fall:

The annual rain fall ranges between 200 – 350mm, in the Northern part of the state with high variability of rainfall from year to year. In the central areas the annual rainfall is between 350 – 450mm and the variability of rainfall is low. The annual rainfall in the Southern part of the state ranges between 450 – 600 mm with low rainfall variability (Anon 2019).

3.4 Experimental Animals:

Thirty six mature ewes ecotype (Dubasi and Shugor) of age (2-3 years) and initial average body weight 36kg and four rams of (3 – 4 year) age and average body weight 45kg were selected for this study. The experimental animals were housed in semi-open pens enclosed by corrugated steel, bamboo poles and steel bars of about three meters high and covered with zinc sheets, the floor is made of concrete with suitable slope for drainage, each pen was equipped with feeding racks, one for the concentrate diet and the other for roughage diet. In each pen water was daily offered in a plastic bucket. In addition to the concentrate and roughages feeds, commercial salt-lick blocks containing trace minerals-vitamins were offered freely to each group of ewes in each pen. The composition of the commercial salt-lick block is shown in Appendix table (2) according to the manufacturing Co.(ELnajm Aldahabi).

3.5 Feeds and feeding:

Three complete diets were formulated to meet two levels of flushing system and three levels of Se and vit.E. A normal control-concentrate diet containing: 13% CP and 11.5 MJ/kg DM of Metabolizable Energy-ME; a

moderate concentrate diet containing 16% CP and 12.8MJ/kg DM of ME and a high concentrate diet containing 18% CP and 13.3MJ/kg DM of ME). In addition to the different concentrate diets, Groundnut hulls was used as a roughage diet. The concentrate diets were based on Sorghum grains and Wheat-bran as energy sources in addition to Groundnut cake as a protein supplement. Ingredients-composition of the different concentrate diets are shown in table (1). Groundnut-hulls was used as the roughage diet for the ewes and rams. The ewes were housed and fed in groups of three for each ecotype. The design was a 2x3x6 randomized complete block design (Two ecotypes of Sudan desert ewes, three experimental diets and three animals per treatment). The trial lasted for seven months and the animals were fed in groups of three with daily fixed quantities of concentrate and roughage diets. Each ewe was daily allotted 0.5 kg concentrate diet +0.75 kg Groundnut hulls-roughage diet, all the animals consumed their daily allowances from both concentrate and roughage diets, in addition to free access to water and saltlick mineral-vit., Commercial premix. The two breeding rams were housed together and fed also in the same manner as the ewes, using the moderate concentrate diet and Groundnut hulls.

3.6 Experimental procedure:

Animals were properly tagged for ease identification, drenched with Albendazole (Bendazole-25, Alpha, Holland) and injected with Ivomec against the internal parasites and treated against the external parasites by using Cipermethrine after been cleaned with soap and water, and given prophylactic doses of oxytetracycline. The experimental animals were initially individually weighed using small ruminant's balance (0 – 50 Kg capacity). Thereafter, ewes within each group were subjected to one of the flowing treatments:

Table (3.1) Shows the Chemical composition (DM-basis) of the experimental diets.

Items	Experimental diets			
	Control Concentrate	**Moderate concentrate**	**High concentrate**	**Roughage-Diet (Groundnut hulls)**
DM %	91.8	86.2	90.2	94.3
OM%	95	95.2	96.0	85.8
CP %	13.0	16.0	18.0	6.2
EE %	3.3	3.9	4.0	1.4
CF %	12.0	9.0	5.0	33.2
Ash %	5.0	4.8	4.0	14.2
NFE %	66.7	66.3	69.0	45.0
*ME_R(MJ/kg DM)	11.5	12.8	13.3	9.1

*ME_R(MJ/kg DM) values were calculated from Proximate analysis values, using the generalized Rostack equation given in Technical Bulletin #33-HMSO- London (1975).

ME_R: ME for ruminants = 0.012 CP + 0.031 EE + 0.005 CF + 0.014 NFE using the analysis expressed as g/kg DM gives values direct as MJ/kg DM.

ME_R: Metabolizable energy for ruminants (MJ/kg DM); CP: Crude protein (g/kg; EE: Ether extract (g/kg); CF: Crude fiber (g/kg) and NFE: Nitrogen free extracts (g/kg).

Table (3.2) ShowsThe ingredients composition of the experimental diets used in feeding the ewes.

Ingredients (%) , as fed-basis	Diets		
	Control Concentrate	Moderate concentrate	High concentrate
Sorghum grains	**40**	**46**	**56**
Wheat bran (W.B)	**16**	**18**	**18**
Groundnut cake(GNC)	**15**	**20**	**22**
Groundnut Hulls(GNH)	**25**	**12**	**2**
Limestone	**2**	**2**	**1**
Common Salt	**2**	**2**	**1**
Total	**100**	**100**	**100**

- Control group in each ecotype represent without flushing and selenium and vit.E injections.
- Moderate concentrate (MC) group flushed without Se and vit.E supplementation.
- High concentrate (HC) group flushed without Se and vit.E supplementation.
- Control+Half dose of Selenium and vitamin E intramuscular injection at the rate of 1ml/head weekly.
- Control+Full dose of Selenium and vitamin E intramuscular injection at the rate of 2ml/head weekly.
- Flushed with high concentrate + Full dose of Selenium and vitamin E intramuscular injection at the rate of 2ml/head weekly. Vitamin E+Selenium injection solution for Intramuscular or Subcutaneous injection (DAD vet.) manufactured in Jordan. Composition of 1ml contained: Vitamin E 60 mg. Selenium (as sodium selenite) 1.5 mg.

To investigate the effects of flushing systems and supplementations of different levels of selenium and vitamin E on the reproductive characteristics, blood haematological and metabolic parameters were measured. The trial continued for about seven months, starting from the beginning of March to the end of September (2019), with the first 45 days for conditioning and adaptation of the ewes prior to mating. Oestrus-synchronization of the ewes was done using prostaglandins. The ewes were taken twice (for about one hr.), during the morning and evening for exercise and mating of the ewes on heat, separately for the Shugor and Dubasi ecotypes with their corresponding breeding rams. Each ewe was first intra-muscularly injected with 1c.c of the commercial Estrumate synthetic prostaglandin (manufactured by: Schering-Ploug Animal Health, Australia) and the ewes were carefully observed for one week for heat symptoms. The ewes were taken twice (for about one hr.), during the morning and evening for exercise and mating of the ewes on heat, separately for the Shugor and Dubasi ecotypes with their corresponding breeding rams. Administration of the hormone prostaglandin was repeated for the ewes not observing heat signs (such as mounting of ewes on heat to other animals, urination, tail movement of the ewes, swelling and redness of the vulva). The mating was repeated many times until eventually all the ewes were mated and conceived. The mating process continued for about 5-6 weeks.

3.7 Acquisition of research material:

The acquisition of samples was performed according to a precisely defined method with the intention to preserve the initial quality of blood and serum. The skin over the jugular vein was rubbed with 70% alcohol and disinfected by the application of tincture of iodine using a labeled vacationer tube with needle holder

or by using disposable plastic tubes. Tubes containing blood samples were placed in racket in small ice box and then were transported to the laboratory. Blood samples were collected in sterile glass tubes after the animals were bleeded from their jugular veins using plastic syringes. Immediately after blood collection samples were transported and transferred into vacuum capillary tubes to determine the immediate measurement of haemetological parameters.

The remaining parts of blood samples were left for 2-3 hours at room temperature after which the serum was clarified and separated by centrifugation for 10 minutes (Hettich EBA20, Germany) at 2000 rpm at room temperature after which the serum was poured in plastic tubes stored in deep freezer at -20c^{o} for metabolic parameters.

3.8 Data collection:

Data recorded were initial and mating body weights of ewes, number of services, conception rate, abortion rate, lambing rate, litter size, ewes- mortality, lamb birth- weight and pre-weaning weights. Chemical composition was also carried for the different concentrate feeds and the roughage diet Groundnut hulls, according to (A.O.A.C, 2005). DM-intake, CP and energy intakes of the different ewes in the different planes of nutrition, blood chemical analysis for both haematologicaly and metabolic parameters were measured and computed, composition of the commercial mineral-vit. Premix was also presented according to the manufacturing company.

3.8.1 Reproductive parameters:

The following reproductive parameters were measured: Estrus cycle, Ovulation, Conception, Abortion, Gestation, Fertility, Lambing rate, Litter size, Lamb birth weight and Pre-weaning growth.

- **Oestrus cycle period**: those ewes seen on heat (sexual desire) were taken to the ram for service. Synchronization of estrus using full dose Prostaglandin hormone, (Estrumate hormone) 2ml/head.
- **oestrus cycle detection:** ewes carried out twice a day for one hour period of observation using the ram.
- **Detection of oestrus and natural services**: ewes and rams were kept together in paddock for one hour twice a day for observing the behavioral signs. The behavior of animals was noted on individual sheets prepared for each ewe. Each ewe was considered to be in estrus when she was directly observed to accept a mount from the ram. The ewes were hand mated/NS twice at 12hrs interval.
- **Ovulation:** An ewe was considered to have ovulated when progesterone concentration was >0.5ng/ml by the measurement of serum progesterone concentration.
- **Conception rates** were determined at the period, based on non-return to oesterus following two mating or inseminations.
- **Pregnancy** was determined by abdominal palpation (ballotement) 90-110 day post-mating. Some other parameters were calculated according to Charring *et al*. (1992) these include:-
- Fertility rate $= \frac{\text{lambed } ewes}{\text{ewes mated}} \times 100$
- Pregnancy rate (%) $= \frac{(\text{number of ewes pregnant} - \text{ewes present to rams})}{\text{ewes present to rams.}} \times 100$ Lambing rate (%) $= \frac{\text{number of ewes lambing}}{\text{Number of ewes mated.}} \text{X } 100$

$$\text{Litter size (prolificacy)} = \frac{\text{Number of lambs}}{\text{Number of ewes lambing.}}$$

$$\text{Lamb survival rate (\%)} = \frac{\text{Number of offspring weaned}}{\text{Number of offspring produced .}} \times 100$$

$$\text{Pre} - \text{weaning Average Daily Gain} = \frac{\text{weaning weight} - \text{birth weight}}{\text{weaning age}}$$

3.8.2 Haematological parameters:

The following haematological parameters were measured: Haemoglobin concentration (Hb), white blood cells (WBCs) count, Red blood cells (RBCs) count and packed cell volume (PCV).

3.8.2.1 Haemoglobin concentration (Hb):

The concentration of haemoglobin was measured by the Cyanmethaemolobin technique using a haemoglobin-meter. The method is based on the conversion of haemoglobin by Drabkin's Solution (0.2g. Potassium cyanide, 0.2g. Potassium ferricyanide and 1gm sodium bicarbonate per liter of distilled water) to cyanmethaemoglobin. Haemoglobin concentration was measured in g/100ml of blood.

3.8.2.2 White blood cells (WBCs) count:

White blood cells were counted with an improved Neubauer haemocytometer (Hawksley and Sons Ltd., England). Turk's fluid (1% glacial acetic acid tinged with gentian violet) was used as a diluent. The number of WBCs is expressed as 10/ml.

3.8.2.3 Red blood cells (RBCs) count:

Red blood cells were counted with an improved Neubauer-haemocytometer (Hawksley and Sons Ltd., England). Formal citrate was used as diluents.

3.8.2.4 Packed cells volume (PCV) count:

Fresh blood samples were centrifuged in a microhaematocrit centrifuge (Hawksley and Sons, Ltd., England) for 5 minutes. The PCV percentage was read off on the scaling instrument provided with the centrifuge.

3.8.3 Metabolic parameters:

The flowing metabolic parameters were measured: Total protein, Albumin, cholesterol, Triglyceride, blood glucose, Calcium and phosphorus.

3.8.3.1 Total protein:

Photometric colorimetric test – biuret method for determination of total protein was used (Gornall *et al*., 1949, Yaung *et al*., 1975, Tietz, 1986) – Cat.

3.8.3.1.1 Test procedure:

Protein in serum or plasma forms a blue/ violet complex when mixed with copper ions in alkaline solution (Biuret reaction), each copper ion binding with 5 or 6 peptides bonds. Tartarate is added as a stabilizer. Iodide is used to prevent auto reduction of the alkaline copper complex. The absorbance of this complex at 546 nm is proportional to the protein concentration.

3.8.3.1.2 Assay procedure:

Tubes	Blank	standard	Sample
Test sample ml	-	-	0.02
Standard ml	-	0.02	-
Distilled water ml	0.02	-	-
Reagent ml	1.0	1.0	1.0

Mix, incubate at room temperature for 5 minutes. Measure the absorbance of the sample (As) and the standard (A std), against the reagent blank within 30 minutes.

3.8.3.1.3 Calculation:

Serum total protein (g/dl) = As / A std × concentration of standard

3.8.3.2 Albumin:

Serum albumin concentration was determined by a spectrophotometer method using a commercial kit (Linear Chemicals, Barcelona, Spain).

3.8.3.2.1 Test procedure:

The measurement of serum albumin is based on the specific binding to the indicator, 3,5,5,5, tetrabromocresol (Bromocresol green, BCG), an anionic dye, and the protein at acid pH 4.2 with the formation of a coloured complex. The intensity of colour produced is proportional to the concentration of albumin in the sample.

Serum was mixed with a buffered BCG reagent and the mixture was incubated for 10 mints at room temperature. The absorbance of the sample (A sample) and of the standard (A standard) was measured against the reagent blank at 630 nm in the spectrophotometer. Serum albumin concentration (c) was calculated as follows.

$$\text{AL (g/dl)} = \frac{\text{T} - \text{B}}{\text{S} - \text{B}} \times 5$$

Where: T: Test, B: Blank, S: Standard, 5: factor

3.8.3.3 Cholesterol:

Cholesterol content was determined using enzymatic, liquid colorimetric test – CHOD/ PAP method as described by (Richmond, 1973; Roeschlau, 1974; Trinder, 1969; Allain, 1974) - Cat. No. CS603.

3.8.3.3.1 Test procedure:

Free and esterified cholesterol originates, by means of the coupled reactions described below, coloured complex that can be measured by spectrophotomety [1.2].

Cholesterol ester $+H_2O$---------- $^{\text{chol.esterase}}$ = cholesterol + Fatty acid.

Cholesterol$+{}^{½}O_2+H_2O$--------chol.oxidase = cholesterol$+H_2O$.

$2H_2O_2$+4-Aminoantipyrine +phenol→ peroxidase = Quinoneimine +4HO.

3.8.3.3.2 Assay procedure:

Bring the reagent to room temperature.

Pipette into labeled test tubes:

Tubes	Blank	Standard	Sample
Test sample ml	-	-	0.01
Chol. Standard ml	-	0.01	-
Distilled water ml	0.01	-	-
Reagent ml	1.0	1.0	1.0

- Mix thoroughly and incubate the tubes for 10 minutes at room temperature (16-25c^0) or for 5 minutes at 37c^0.

- Measure the absorbance (A) of the standard and sample at 500nm against the blank. The colour is stable for at least 2 hours within 60 minutes.

- Cholesterol con. (Mg/dl) = As /A STD × concentration of A standard to convert mg/dl to mmol/l, Cholesterol.

- A sample = 200mg/dl cholesterol.

- A standard =5.18mmol/l cholesterol.

3.8.3.4 Triglycerides:

The method depends on the enzymatic hydrolysis of serum or plasma triglycerides to free fatty acids (FFA) by lipoprotein lipase (LPL). The glycerol is phosphrylated by adenosine tri- phosphate (ATP) in the presence of glycerolkinase (GK) to form glycerol-3-phosphate (G-3-P), adenosine diphosphate (ADP) and hydrogen peroxide. A red chromogen is produced by the peroxides (POD) catalyzed coupling of 4-aminiatipyrine (4-AA) and phenol with hydrogen peroxide (H_2O_2), proportional to the concentration of triglyceride in the sample.

Triglycerides +$H_2O \xrightarrow{LPL}$ Glycerol +3FFA

Glycerol +ATP $\rightarrow^{GK}$ Glycerol-3-P+ADP

Glycerol-3-p+$O_2 \rightarrow^{GPO}$ DHAP +H_2O_2

4-AA +4phenol$\rightarrow^{H2O2}_{POD}$ Quinoneimine +H_2O

3.8.3.4.1 Assay procedure:

The reagent was brought to room temperature and Pipetted into labeled test tubes (as shown below):

Tubes	Blank	Standard	Sample
Test sample ml	-	-	0.01
Trigl. Standard ml	-	0.01	-
Distilled water ml	0.01	-	-
Reagent ml	1.0	1.0	1.0

- Tubes were thoroughly mixed and incubated for 15 minutes at room temperature (16-25c^0) or for 5 minutes at 37c^0.

-The absorbance (A) of the standard and sample at 500nm was read against the blank. The colour was stable for at least 1 hour when protected from light.

Triglycerides con (mg/dl) = As /A std × C standard = mg/dl triglycerides

To convert mg/dl to mmol/l, Cholesterol

A sample = 800mg/dl triglycerides.

A standard = 0.0113mmol/l triglycerides.

3.8.3.5 Blood glucose:

The developed colour intensity is related to glucose concentration and is measured photometrically. Glucose buffer 150m mol/L phosphate buffer pH 7.0 and 10m mol/L phenol were added to all tubes. The standard reagent (1) glucose 200mg/dl was added to standard tube and serum was added to anther tubes. The absorbance of the standard and samples were read against blank reagent in a spectrophotometer (Corning 252, England) at a wavelength of 492 nm, after 10 minutes.

3.8.3.6 Calcium:

For quantitative determination of calcium in serum, plasma and urine the methods used were as follows:

3.8.3.6.1 Test procedure:

The O-Cresolphthalein complex one (O-CPC), reacts in alkaline medium with calcium to yield a colour complex. The intensity of the colour is directly proportional to the amount of calcium present in the sample. The 8-hydroxylquinoline eliminates magnesium interference.

3.8.3.6.2 Reagent preparation and stability:

The Reagent (R2) is limpid colour less; Reagent (R3) is limpid pale yellow mix in the ration 1:1Reagents (R2) and (R3).

Tubes	Blank	Standard	Sample
Test sample ml	-	-	1.0
Standard ml	-	1.0	-
Distilled water ml	1.0	-	-
Reagent (R2+R3)	1.0	1.0	1.0

-The tubes containing reagents were mixed of incubated for 5 minutes at room temperature (20-25c^0) or for 5 minutes at 37c^0.

-Absorbance of the standard and sample against the blank was read. The colour was stable for at least 60 minutes.

3.8.3.6.3 Calculations:

Serum calcium (mg/dl) = As /A std ×10

3.8.3.7 Phosphorus:

3.8.3.7.1 Test procedure:

Inorganic phosphorus reacts with molybdic acid forming a phosphomolybdic complex. Its subsequent reduction in alkaline medium originates a blue molybdenum colour. The intensity of the colour formed is proportional to the inorganic phosphorus concentration in the sample

3.8.3.7.2 Preparation:

Working reagent (WR):

Equal volumes of R1 (molybdic) and R2 (catalyzer) were mixed

Stability: 10h at 2-8c, protected from light.

1-Assay conditions**:**

Wavelength: ……710 nm (620-750).

Cuvette: …….1 cm. light path.

Temperature: ……..37 c^0 /15-25c^0.

2-The instrument was adjusted to zero with distilled water.

3-Pipette into a cuvette:

Tubes	Blank	Standard	Sample
sample ml	-	-	0.50
Standard ml	-	.50	-
WR (ml)	1.5	1.5	1.5

-The tubes were mixed of incubated for 10 minutes at room temperature (15-30c^0) or for 5 minutes at 37c^{0m}.

-The absorbance (A) of the standard (calibrator) and sample was read against the Blank. The colour is stable for at least2 hours.

3.8.3.7.3 Calculations:

Serum:

(A) Sample / (A) calibrator ×5 (calibrator conc.) = mg/dl of phosphorus in the sample.

3.9 Statistical Analysis:

Data were reported as means ± S.E.M and were subjected to analysis of variance (ANOVA). Differences between groups means were tested with the Duncan multiple range tests. Means were considered significant at ($P \leq o.o5$ and $P<0.01$) levels. Statistical analysis was performed using computer software SPSS.18.0 (26) for windows.

CHAPTER FOUR

RESULTS

In this study ewes were classified into six experimental groups (three ewes/group) from each ecotype: Shugor and Dubasi i.e. (6x3x2=36 ewes). Group (A) was control (6 ewes three from each ecotypes without supplement with Se and vit.E, only receiving the control concentrate diet 13%CP and 11.5MJ/kg DM of ME and the roughage Groundnut hay. Group (B) fed the moderate concentration diet + the roughages diet without Se and vit.E Supplementation. Group (C) fed the high concentrate diet + roughages and also without Se and vit.E. Group (D) fed the control diet + half dose of Se and vit.E. Group (E). control diet + full dose of Se and vit.E. Group (G) high concentrate diet +full dose of Se and vit.E .

4.1 Effects of flushing systems (moderate concentrate and high concentrate) on some reproductive parameters:

4.1.1 Effect on oestrus, conception, ovulation, gestation, abortion and ewes mortality:

Table (4.1) shows the effects of flushing systems (control, moderate and high concentrate diets) on oestrus, conception, ovulation, gestation, abortion and ewes mortality. The two flushing systems associated with oestrus synchronization enhanced ovulation rate without increase in ova loss when compared with the control group. The effects of flushing on ewes reproductive performance indicated that flushed ewes had higher oestrus and ovulation rates ($P \leq 0.05$) compared to control group. Un-flushed ewes were unable to reach high ovulatary, probably due to the fact that nutritional requirements to optimize ovulation in pre-mating period were not met, because the available feed allowances in this pre-mating period were below the level required to optimize ovulation rate in ewes mated in control group. A high significant difference ($P \leq 0.05$) was recorded for

conception rate in Shugor ecotype, while Dubasi recorded non-significant differences (Table 4.1). Abortion rate of 33% was recorded in control group of Dubasi. The two flushing systems reduced abortion ($P \leq 0.05$) and minimized pregnancy stresses and caused no ewe mortality (table 4-1).

The gestation period for all experimental animals (flushed and control) recorded an average gestation period ranging from 148days to 151days, without any statistical significant differences between all animals. The two flushing systems used in this study was reflected good potential in improving oestrus rate, ovulation rate, conception rate, lamb abortion and ewes mortality (Table 4.1).

Collectively the findings highlighted that nutritional flushing before mating is particularly important to the subsequent reproductive success in desert sheep of Gezira (Shugor and Dubasi).

4.1.2 Effects on fertility:

Table (4.2) shows the effects of flushing on fertility, lambing rate and litter size. Results of this table showed high significant ($P \leq 0.05$) effects for flushing groups. Both groups recorded 100% and 133% for moderate and high conc. groups, respectively for both ecotypes in comparison to 67% for the control group (Table 4.2). The two flushing systems influenced ruminant fertility directly by the supply of specific nutrients required for the process of oocyte and spermatozoa development, ovulation, fertilization, embryo survival and establishment of pregnancy. The results beside confirming the beneficial effects of flushing also agreed with most reported literature (O'Callaghan and Boland, 1999; Tatman *et al.*, 1990).

Table (4.1) shows the effects of flushing systems on estrus, conception, ovulation, gestation, abortion and ewes mortality rates

Items studied	Breed							
	Shugor				Dubasi			
	Control	Moderate	High	level	Control	Moderate	High	Level
No of ewes	3	3	3		3	3	3	
No of ewes exhibited estrus	2	3	3	NS	2	3	3	NS
Average service weight (kg)	44.8 ±1.09	42.3 ±1.03	41.8 ±0.93	NS	35.6^{c} ±1.01	41.6^{a} ±1.00	39.4^{b} ±1.06	*
Ewes exhibited estrus%	66.67^{b}	100^{a}	100^{a}	*	66.67^{b}	100^{a}	100^{a}	*
No of service/conception	2	3	3	NS	3	3	3	NS
Conception rate% from total ewes	67	100	100	*	100	100	100	NS
Gestation period (days)	150	148	150	NS	151	150	148	NS
Abortion rate%	0.0	0.0	0.0	NS	33.3	0.0	0.0	*
Ewes mortality rate	0.0	0.0	0.0	NS	0.0	0.0	0.0	NS

[a-b] Means within rows with no common superscripts are significantly different.(*P≤0.05).

The values in the same row with different superscripts are significantly different (P≤0.05). *: significantly

It also influenced fertility indirectly through its impact on circulation of hormones and other nutrients sensitive metabolites that are required for the success of these processes. The high fertility result may be due to the role of flushing in the first stage of pregnancy and also in addition to extra release of hormones of estrogen. Fig.(4.1) shows the influence of flushing on fertility percentage. Both moderate and high groups recoded 100% and 133%, respectively, with higher.

4.1.3 Effects on lambing rate:

In this study the lambing rate recorded were 67%, 100% and 133% for control and the two flushing groups (moderate and high conc.) and for both ecotypes, respectively. Those finding are in line with Mukhtar and Fadlalla (1988) who found that flushing resulted in 17% increase in lambing rate and 21% decrease in abortion rate. Our results are comparable to the results of Girma (2008) who reported that lambing rate for tropical breeds varies between 108% and 175% with an average of 138%. Fig (4-2) shows the influence of flushing on lambing rate. It is evident from figure that ewes fed moderate and high conc. recorded the highest lambing rate.

4.1.4 Effects on litter size:

In this study the litter size recorded 0.67, 1 and 1.33 for the control and two flushing systems (moderate and high conc.) and for both ecotype, respectively. This outcome confirms the positive effect of flushing on litter size. Our result is in line with Sulieman (1979) who reported a litter size for Shugor, Dubasi and Watish to be 1.30, 1.18 and 1.70, respectively. Sulieman and Eissaw (1984) reported that Shugor had more litters (1.25) than either Dubasi and Watish (1.6) although the difference were statistically non-significant.

Table (4.2) shows the effects of flushing on fertility, lambing rate and litter size.

Type of feed	Breeds	No of ewes	Fertility %	Lambing rate	Litter size	Level of Sig.
Control	Shugor	3	67	67%	0.67	NS
	Dubasi	3	67	67%	0.67	NS
Moderate concentrate	Shugor	3	100	100%	1	NS
	Dubasi	3	100	100%	1	NS
High concentrate	Shugor	3	133	133%	1.33	NS
	Dubasi	3	133	133%	1.33	NS

A: Control group. B: fed with moderate concentrated feed. C: fed with high concentrated feed.

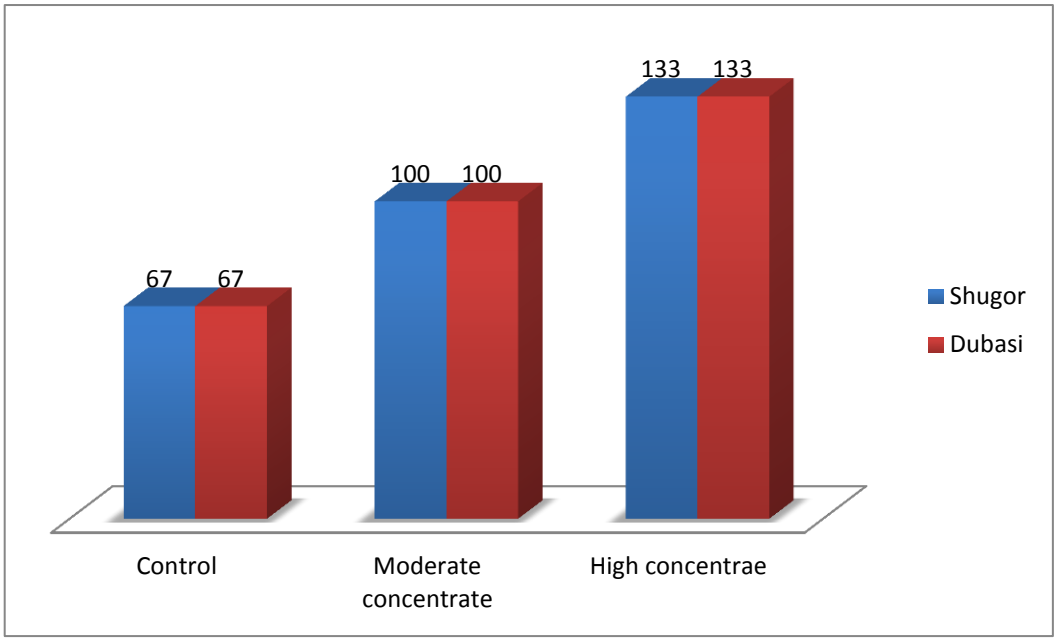

Fig. (4.1) shows the influence of flushing on fertility percentage

Fig (4.3) shows the influence of two flushing system (moderate and high conc.) on litter size. Both ecotypes recorded 1 and 1.3 for moderate and high conc. groups, respectively.

4.1.5 Effects on lamb birth weight:

Table (4.3) shows the effects of flushing on lamb birth weight and pre-weaning growth rate. Flushed ewes had significantly heavier lamb birth weight compared to control group. Reese *et al*., (1990) reported that energy resulted in significant ($P \leq 0.05$) and positive effect on lamb birth weight.

In this study Shugor recorded a lamb birth weight ranging 4.62kg to 3.8kg, while Dubasi recorded a range from 4.56kg to 3.76kg (table 4.3). This result is in line with the result reported by Sulieman *et al*., (1996) who reported that lamb birth weight for Sudan desert sheep at El-Huda research station include Shugor, Dubasi and Watish ecotypes were ranging from 2.5kg to 4.2kg. Other workers also agreed with Sulieman *et al* (1990), El-Amin and Rizgalla (1979), Wilson (1976) and El-Hag *et al*. (2001).

4.1.6 Effects on pre-weaning growth rate:

Table (4.4) shows the effects of flushing on lamb birth weight and pre-weaning growth rate. Shugor recorded a significant difference ($P \leq 0.05$) between diets in the age of one month, while Dubasi recorded non-significant difference. The results of Shugor were similar to the results of Sulieman *et al*., (1990) for the first month of age. Dubasi recorded high significant differences for the pre-weaning growth rate at the age of 60 and 120days, while Shugor recorded significant differences ($P \leq 0.05$) at the age of 120days those results were similar to the results reported by Sulieman *et al*., (1990) who mentioned that growth rate from birth to 30days neither differ among subtypes nor influenced by other sources of variations i.e sex of lamb season of birth and parity, whereas from 60 to 120days there are differences in growth rate among genotypes between sexes and between single and twin lambs born in different seasons and different years.

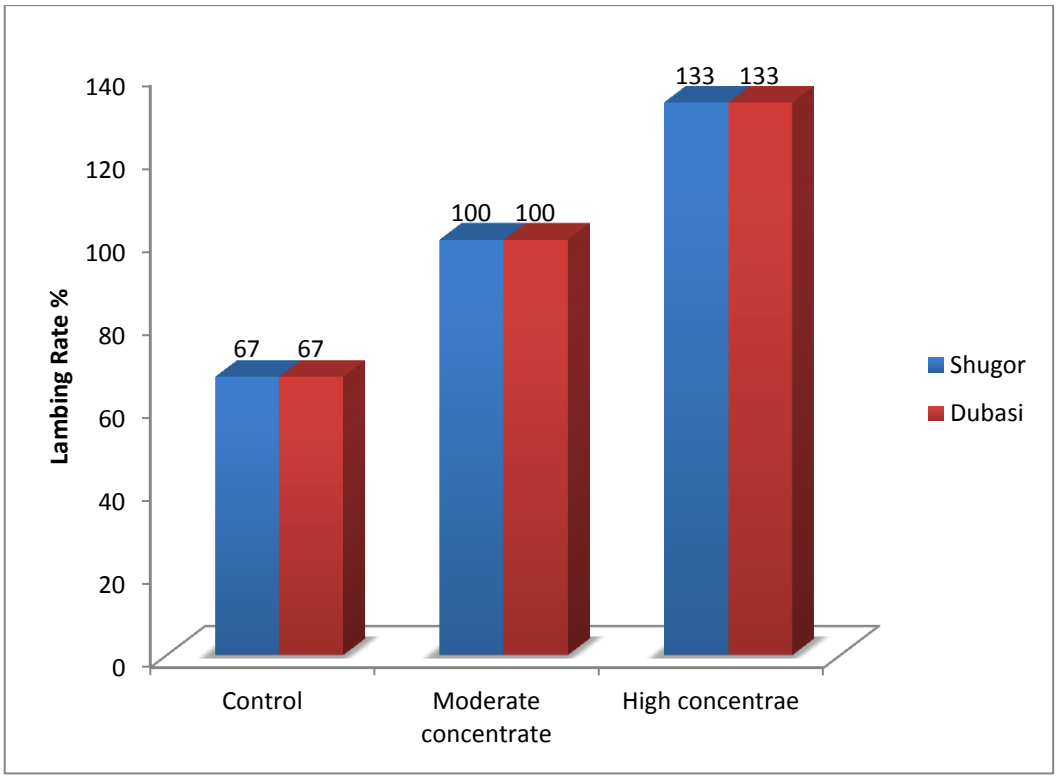

Figure (4.2): Shows the influence of flushing on lambing rate

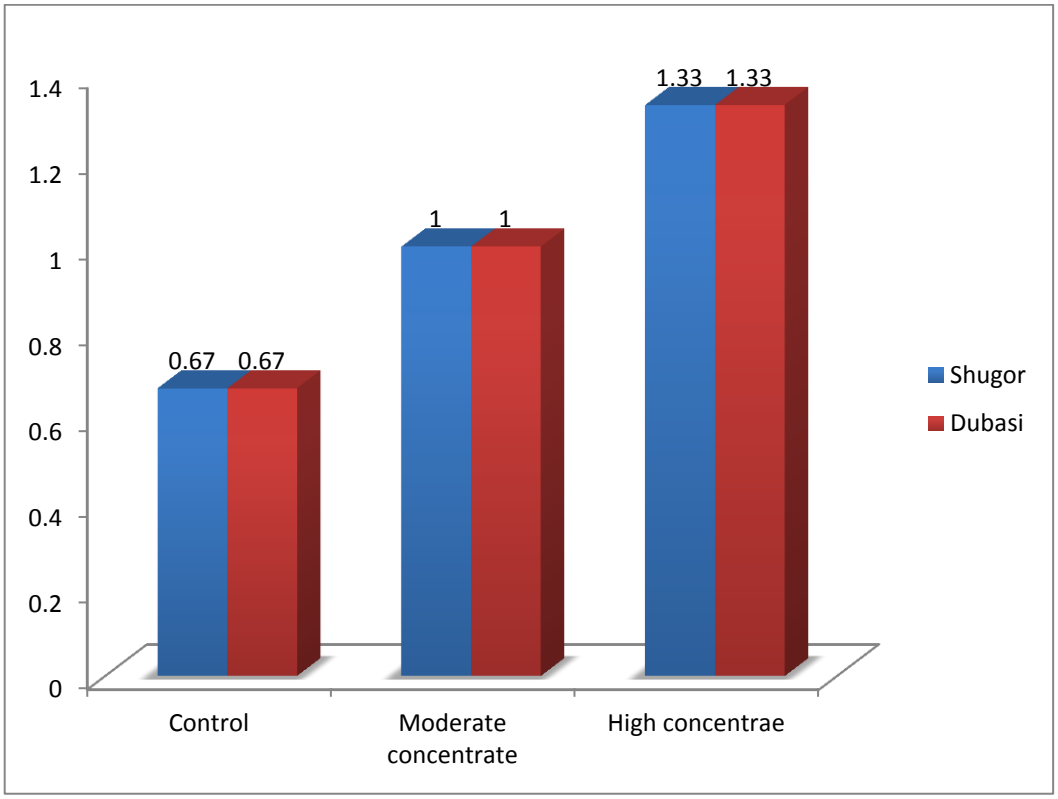

Figure (4.3): Shows the influence of flushing on litter size

Table (4.3) shows the effects of flushing on lamb birth weight/kg.

Treatments	Breeds	No of ewes	No of lambs Born	Lamb birth weight/kg (means)	Sig.level
Control	Shugor	3	2	4.35	NS
	Dubasi	3	2	4.50	NS
Moderate concentrate	Shugor	3	3	4.62	NS
	Dubasi	3	3	4.56	NS
High concentrate	Shugor	3	4	3.80	NS
	Dubasi	3	4	3.76	NS

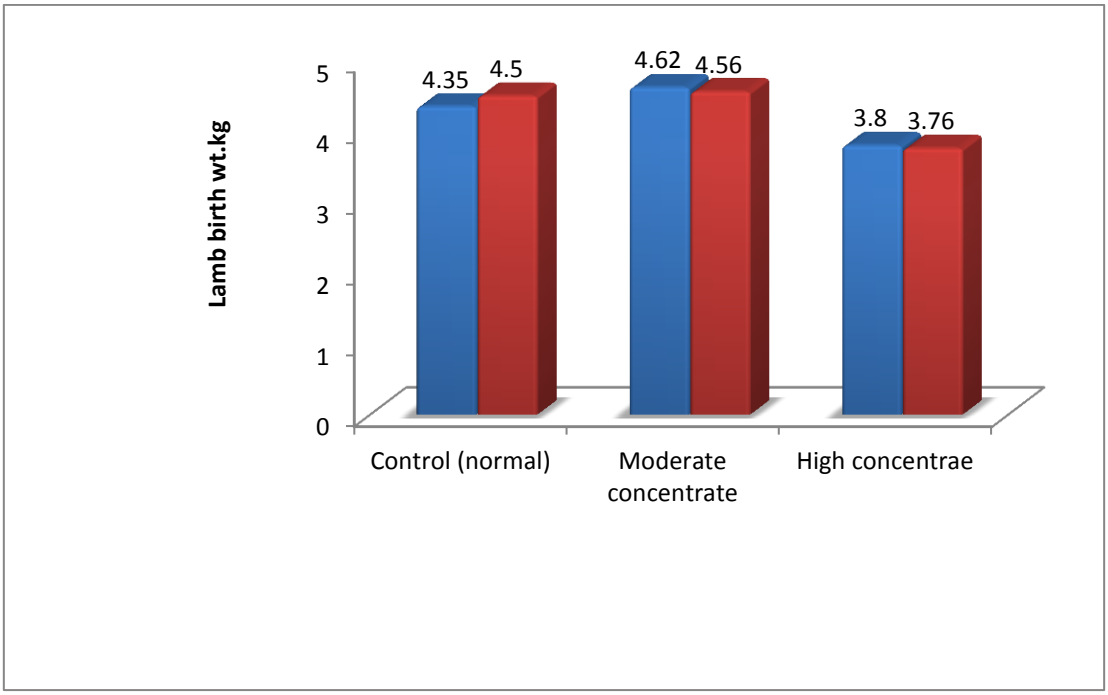

Fig (4.4) shows the effects of flushing on lamb birth weight/kg

Table (4.4) shows the effects of flushing on pre-weaning growth rate

Lamb weight								
Breed	**Shugor**				**Dubasi**			
Item	**Control**	**Moderate**	**High**	**Sig level**	**Control**	**Moderate**	**High**	**Sig level**
No of lamb	2	4	4		3	4	4	
First month	12.5±1.4	10.7±1.1	12.0±1.4	*	12.6±1.7	9.8±9	11.1±1.2	NS
Second month	20.1±3.9	19.1±3.1	21.0±5.5	NS	17.1±2.6	14.2±2.2	21.0±3.1	*
Third month	26.1±5.5	25.2±4.6	28.6±7.7	*	22.6±5.3	19.2±2.6	26.4±5.4	*

[a-b] Means within rows with no common superscripts are significantly different.

The values in the same row with different superscripts are significantly different ($P \leq 0.05$). *: significantly

4.1.7 Blood metabolites:

Table (4.5) shows the effects of flushing on serum blood components for total protein, albumin, glucose and cholesterol (biochemical parameters). High statistical differences were recorded for total protein, albumin and glucose in the third month for both Shugor and Dubasi ecotypes. Cholesterol recorded a high statistical difference ($P \leq 0.05$) in second and third months for both ecotypes. Result of this study, indicate high significant difference at ($P \leq 0.05$) level in the third month for total protein, albumin, glucose and cholesterol for all experimental groups and for both ecotypes this confirm the beneficial effects of flushing on these metabolites in blood of ruminants.

Table (4.6) shows the effects of flushing on serum blood components (triglycerides mg/dl, calcium g/dl and phosphorus g/dl). Triglycerides recorded a high statistical ($P \leq 0.05$) difference in the first, second and third months for Dubasi ecotype, while Shugor recorded non-significant difference. Calcium recorded a high significant difference at ($P \leq 0.05$) level in the first, second and third month for Dubasi, while, Shugor recorded a high significant difference ($P \leq 0.05$) in the first month only. Phosphorus recoded a high significant difference ($P \leq 0.05$) in the first and second month for Shugor, while Dubasi recorded non-significant differences. Results of this table confirm the positive effects of the flushing in improving levels of triglycerides, calcium and phosphorus metabolites and hence improving reproductive performance of ewes.

In general flushing regimes used in this study, changed metabolites profile of the treated ewes, it increased blood serum total protein, albumin, glucose, total cholesterol, triglycerides, calcium and phosphorus levels.

Table (4.5) shows the effects of flushing components (biochemical parameters) on: Serum blood, total protein, albumin, glucose and cholesterol

Ecotypes	Periods	Treatments				
		Control	Moderate	High	SEM	Sig level
Total protein(g/dl)						
Shugor	0	6.19	6.23	6.23	0.07	NS
	1 month	6.23	6.26	6.25	0.12	NS
	2 month	6.32	6.31	6.28	0.16	NS
	3 month	6.25^{b}	6.45^{ab}	6.42^{ab}	0.07	*
Dubasi	0	6.21	6.28	6.29	0.05	NS
	1 month	6.34	6.31	6.30	0.10	NS
	2 month	6.39	6.38	6.34	0.13	NS
	3 month	6.39^{b}	6.50^{b}	6.50^{b}	0.03	*
Albumin(g/dl)						
Sugar	0	4.14	4.21	4.20	0.03	NS
	1 month	4.18	4.23	4.26	0.04	NS
	2 month	4.25	4.29	4.32	0.04	NS
	3 month	4.41^{b}	4.37^{b}	4.36^{b}	0.35	*
Dubasi	0	4.17	4.22	4.24	0.03	NS
	1 month	4.25	4.27	4.28	0.04	NS
	2 month	4.29	4.31	4.36	0.03	NS
	3 month	4.33^{b}	4.41^{a}	4.40^{a}	0.02	*
Glucose (mg/dl)						
Shugor	0	49.92	50.56	48.67	1.26	NS
	1 month	51.45	53.41	51.74	1.69	NS
	2 month	52.15	55.50	55.59	1.36	NS
	3 month	49.80^{b}	56.44^{ab}	60.09^{a}	2.26	*
Dubasi	0	41.15	42.51	41.70	1.69	NS
	1 month	45.95	47.69	46.48	1.12	NS
	2 month	47.59^{b}	52.22^{a}	51.34^{ab}	1.35	*
	3 month	50.88^{c}	54.98^{b}	54.53^{b}	0.89	*
Cholesterol (mg/dl)						
Shugor	0	41.54	42.27	43.04	2.09	NS
	1 month	42.49	44.77	43.58	1.09	NS
	2 month	43.63^{b}	47.53^{ab}	47.58^{ab}	1.37	*
	3 month	45.60^{c}	51.66^{b}	53.52^{ab}	0.83	*
Dubasi	0	46.62	45.73	44.58	0.70	NS
	1 month	49.57	52.48	49.50	0.52	NS
	2 month	51.40^{b}	56.63^{a}	$53.58a^{b}$	1.25	*
	3 month	53.66^{b}	59.60^{a}	56.47^{ab}	1.09	*

$^{a-b}$ Means within rows with no common superscripts are significantly different. The values in the same row with different superscripts

are significantly different ($P<0.05$). *: significantly

Table (4.6): Shows the Effects of flushing on serum blood components on: (triglycerides mg/dl, Calcium g/g/dl and Phosphorus g/dl)

Ecotypes	Periods	Treatments				
		Control	Moderate concentrate	High concentrate	SEM	Sig level
Triglyceride (mg/dl)						
Shugor	0	33.37^{ab}	43.35^{ab}	30.91^{b}	6.29	*
	1 month	44.98	43.77	47.06	3.30	NS
	2 month	51.76	54.06	58.24	3.71	NS
	3 month	47.67	44.71	42.06	3.29	NS
Dubasi	0	41.89	38.82	47.34	3.56	NS
	1 month	47.59^{ab}	43.75^{b}	54.63^{a}	2.88	*
	2 month	58.49^{a}	53.63^{a}	43.88^{b}	2.91	*
	3 month	53.63^{a}	43.88^{b}	56.22^{a}	2.70	*
Calcium (g/dl)						
Shugor	0	15.81	15.76	16.08	0.84	NS
	1 month	11.31^{a}	8.26^{b}	10.00^{ab}	0.62	*
	2 month	10.65	10.17	9.95	0.49	NS
	3 month	10.22	8.50	9.48	0.70	NS
Dubasi	0	14.34	15.50	13.09	1.46	NS
	1 month	10.16^{ab}	10.59^{ab}	10.93^{a}	0.45	*
	2 month	10.05^{ab}	9.80^{b}	11.34^{a}	0.44	*
	3 month	9.76^{b}	9.26^{b}	10.53^{a}	0.43	*
Phosphorus (g/dl)						
Shugor	0	4.62	5.61	4.94	0.47	NS
	1 month	3.51^{b}	5.25^{a}	3.68^{b}	0.45	*
	2 month	4.34^{b}	6.78^{a}	6.06^{ab}	0.62	*
	3 month	5.28^{b}	7.25^{a}	6.96^{a}	0.43	*
Dubasi	0	5.43	4.49	5.36	0.56	NS
	1 month	4.93	4.39	4.75	0.61	NS
	2 month	5.63	4.98	5.59	0.40	NS
	3 month	6.53	6.02	6.22	0.33	NS

$^{a-b}$ Means within rows with no common superscripts are significantly different.

The values in the same row with different superscripts are significantly different ($P<0.05$). *: significantly

The increase of these metabolites was associated with improvement in production capabilities, reproductive performance and positive energy balance in small ruminants and this is in full agreement with Hashem and Zarkouny (2016) who worked on goats. Glucose and amino acids have been reported to be involved in ovulation rate and fertilization in sheep. Ovulation rate (OR) is closely associated with glucose energy (Rowe, 1986). Landau (1993) reported that nutritional treatment which increase glucose energy rates also induce higher (OR) in Booroola crossbred ewes. Ovulation rate was equally increased by intravenous (IV) glucose infusion or lupin grain supplementation in Merino ewes (Teleni *et al*., 1989). Downing *et al*. (1992) reported that branched amino acids are associated with increase in (OR). Blood metabolites influence fertility indirectly through its impact on circulation of hormones and other nutrients sensitive metabolites that are required for the success of these processes. These results are in line with Landau and mole (1997) who stated that a short term feed supplementation before mating positively influences ovulation.

4.2 Effects of flushing and supplementation levels of Selenium and vit. E on some reproductive parameters

Table (4.7) present the results derived from the analysis of variance for the effects of flushing and three supplementation levels of Se+vit.E on some reproductive traits. Results of this table showed high positive effects for flushing and supplementation levels of Se+vit. E on reproductive traits, there were found to be more effective in improving fertility, lambing rate and litter size.

4.2.1 On fertility:

Results of table (4.7) present the result derived for the effect of two flushing systems and three supplementations levels of Se+vit.E on fertility percentage. This result indicates high percentage ($P \leq 0.05$) level of fertility for all experimental groups. In this study a fertility percent of 100%, 133%,

100%, 133% and 133% were recorded for Shugor, while Dubasi recorded 100%, 133%, 100%, 100% and 133% for moderate concentrate, high concentrate, control+½dose of Se+vit.E, control+full dose of Se+vit.E and high concentrate +full dose of Se+vit.E experimental groups, respectively. The control group recorded 67% fertility. Fig (4.5) illustrates the fertility percentage for all experimental groups and for the two ecotypes. The highest fertility was recorded for moderate concentrate and high concentrate +full dose of Se+vit.E experimental groups for both Shugor and Dubasi ecotypes, this result besides confirming the beneficial effect of flushing and supplementation of Se+vit.E also in line with, most reported literature (O'Callaghan and Boland, 1999**;**Tatman *et al*., 1990).

4.2.2 On lambing rate:

Table (4.7) Fig. (4.6) record a summary of results derived from analysis of variance for the effects of flushing and supplementation levels of Se+vit.E on lambing rate. In this study, the lambing rate were 67%, 100%, 133%,100%, 133% and 133% for Shugor, while Dubasi recorded 67%, 100%, 133%, 100%, 100% and 133% for control, moderate, high concentrate, control+½dose of Se+vit.E, control +full dose of Se+vit.E and high concentrate full dose of Se+vit.E experimental groups, respectively. Fig (4.6) shows the influence of the flushing and supplementation levels of Se+vit.E on lambing rate. It is evident from the figures that ewes fed high concentrate diet without supplementation and high concentrate diet supplementation with full dose of Se+vit.E diets recorded the highest lambing rates. However, supplementation with full dose of Se+vit.E was effect with animals fed on the control diet only.

Table (4.7) shows the effect of two flushing systems and three supplementation levels of Selenium and vitamin E on fertility, lambing rate and litter size

Treatments	Breeds	No of ewes	Fertility %	Lambing rate	Litter size
Control	Shugor	3	67%	67%	0.67
	Dubasi	3	67%	67%	0.67
Moderate Concentrate	Shugor	3	100%	100%	1
	Dubasi	3	100%	100%	1
High Concentrate	Shugor	3	133%	133%	1.33
	Dubasi	3	133%	133%	1.33
Control+ half dose of Se and vit.E	Shugor	3	100%	100%	1
	Dubasi	3	100%	100%	1
Control+ full dose of Se and vit.E	Shugor	3	133%	133%	1.33
	Dubasi	3	100%	100%	1
High conc+full dose of Se+vit E	Shugor	3	133%	133%	1.33
	Dubasi	3	133%	133%	1.33

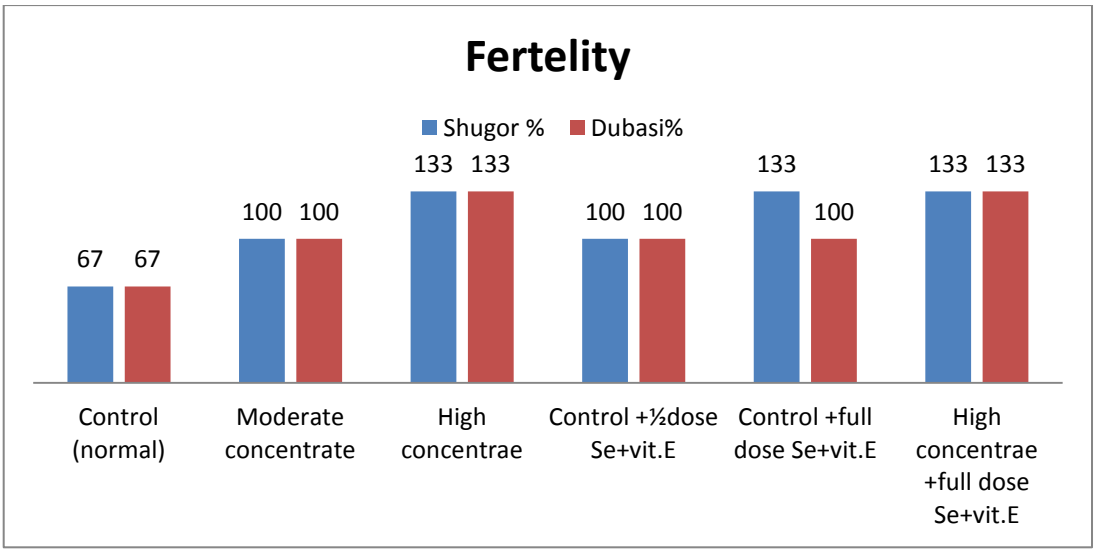

Fig (4.5) shows the influence of flushing and Supplementation levels of Selenium and vitamin E on fertility percentage

4.2.3 On litter size:

The effects of flushing and supplementation with Se+vit.E on litter size followed the same trend as for lambing rate. Table (4.7) presents the results derived from analysis of variance for the effects of flushing and supplementation levels of Se+vit.E on litter size. In this study the litter size recorded were 0.67, 1, 1.33, 1, 1.33 and 1.33 for Shugor, while Dubasi recorded 0.67, 1, 1.33, 1, 1and 1.33 for control, moderate and high concentrate diets, control supplemented with half dose of Se+vit.E, control+full dose of Se plus vit.E and high concentrate+full dose of Se plus vit.E experimental groups, respectively.

The highest litter size were recorded for high concentrate and high concentrate+full dose of Se+vit.E experimental groups which also confirm the positive effect of flushing and supplementation of Se+vit.E on litter size (fig4.7). The results were is in line with Pilarczyk *et al*., (2004) who found significant improvement in reproductive indices (fertilization 96% and fecundity 137%) after application of sodium Selenite in ewes.

4.2.4 On lamb birth weight

Table (4.8) and Fig (4.8) represents the influence of flushing and supplementation of Se and vit.E on lamb birth weight. In this study Shugor recorded a lamb birth weight ranging from 4.9 kg to 3.65 kg, while Dubasi recorded a lamb birth weight ranging from 3.85kg to 3.76 kg.

The data in Table (4.8) showed that the highest birth weight was 4.9 kg which is recorded for control supplementation with half dose of Se plus vit.E experimental group for Shugor, while high conc. and high conc. supplementation with full dose of Se+vit.E groups recorded lower lamb birth weight due to the fact they gave birth to twins.

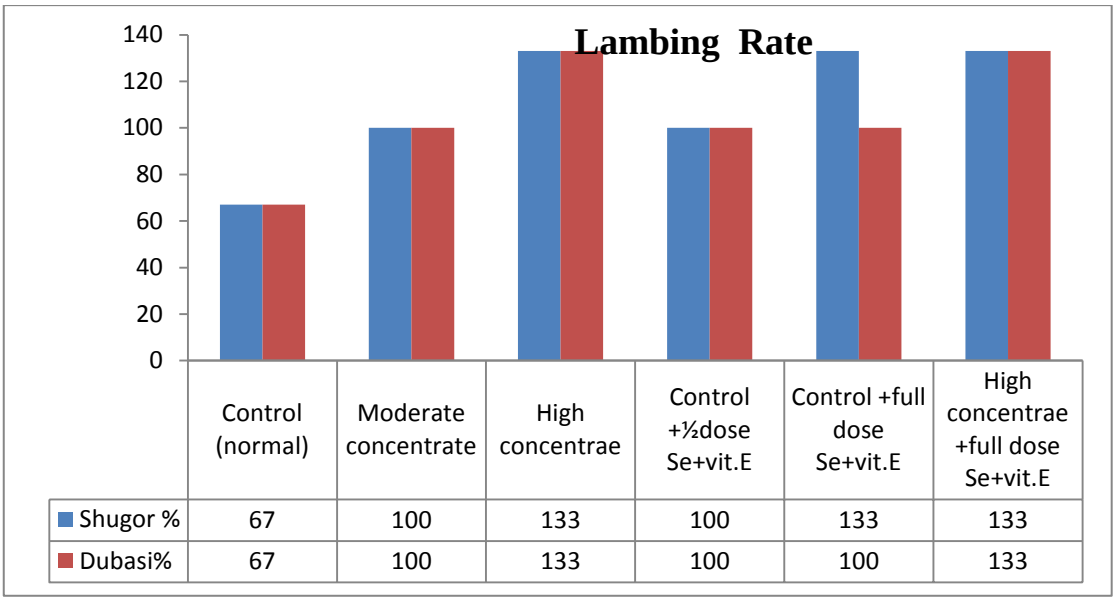

Fig (4.6) Influence of flushing and supplementation of Selenium and vitamin E on lambing rate

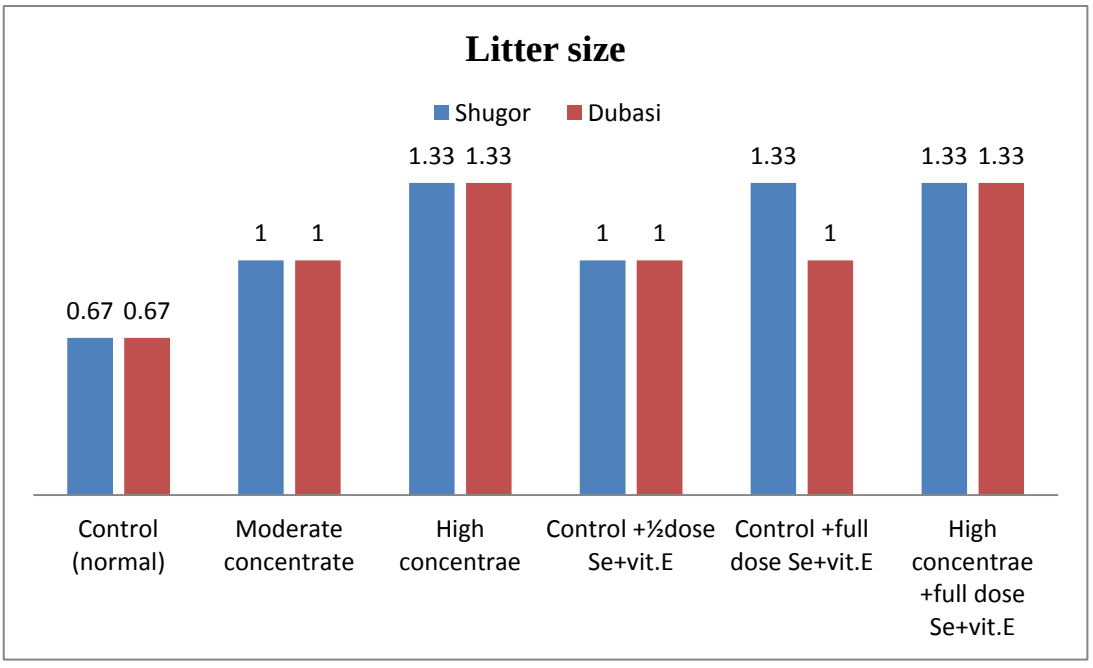

Fig (4.7)Shows the Influence of flushing and supplementation of Selenium and vitamin E on litter size

Flushed and supplemented ewes had significantly heavier (P≤0.05) lamb birth weights compared to control groups. Our results are in line with Reese *et al*., (1990) who reported that energy and supplementation of Selenium plus vitamin E had resulted in positive effects on lamb birth

weight. Our results are also in line with Rosales Nieto (2016); Segerson *et al*, 1980; Gentry *et al*; 1992 Capper *et al*, 2005) who all reported a significant increase in lamb birth weight with increased dietary vitamin E to pregnant ewes. Administration of Selenium improved daily weight gain in lambs (Gabryszuk and Klewiec, 2002) and reproductive performance. Dietary Selenium and vitamin E injection to ewes in late gestation and during lactation improved performance and livability of lambs (Ali *et al*., 2004).

4.2.5 On pre-weaning weight

Table (4.9) shows a significant difference ($P \leq 0.05$) for pre-weaning growth rate at age of one month for all experimental groups. The mean weight of (11.57kg and 11.56 kg), (18.70kg and 17.48kg) and (25.53 kg and 22.63 kg) were recorded for the weights at age of 30, 60 and 120 days of age for Shugor and Dubasi, respectively. Soliman *et al*. (2012) reported that injections of vitamin E and Selenium to ewes at four weeks late gestation and during sucking period for twelve weeks significantly improved average body weight to weaning. Koyuncu and Yerlikaya (2007) reported that lambs from ewes supplemented with Selenium plus vitamin E had a higher birth weight. Daily weight gain and body weight at 60 days of age compared to lambs from ewes received Selenium only. El-Shahat and Abdel Monem (2011) reported that supplementation of baladi ewes with 50mg + vit.E 0.3mg of Se/kg diet starting 2 weeks before mating and extended through pregnancy till lambing had significantly improved their reproductive performance and growth performance of their lambs from birth to weaning compared to lambs from ewes supplemented with vit ,E or Selenium alone.

Table (4.8) shows the effects of flushing and supplementation level of selenium and vit.E on lamb birth weights (kg).

Treatments	Breeds	No of ewes	No of lambs born	Lamb birth weight (means)	Sig. level
Control	Shugor	3	2	4.35	NS
	Dubasi	3	2	4.50	NS
Moderate concentrate	Shugor	3	3	4.62	NS
	Dubasi	3	3	4.56	NS
High concentrate	Shugor	3	4	3.80	NS
	Dubasi	3	4	3.76	NS
Control+½ dose of Se+vit E	Shugor	3	3	4.90	NS
	Dubasi	3	3	4.85	NS
Contol+full dose of Se + vit.E	Shugor	3	4	3.65	NS
	Dubasi	3	3	4.79	NS
High conc.+ full dose of Se+vit.E	Shugor	3	4	3.66	NS
	Dubasi	3	4	3.85	NS

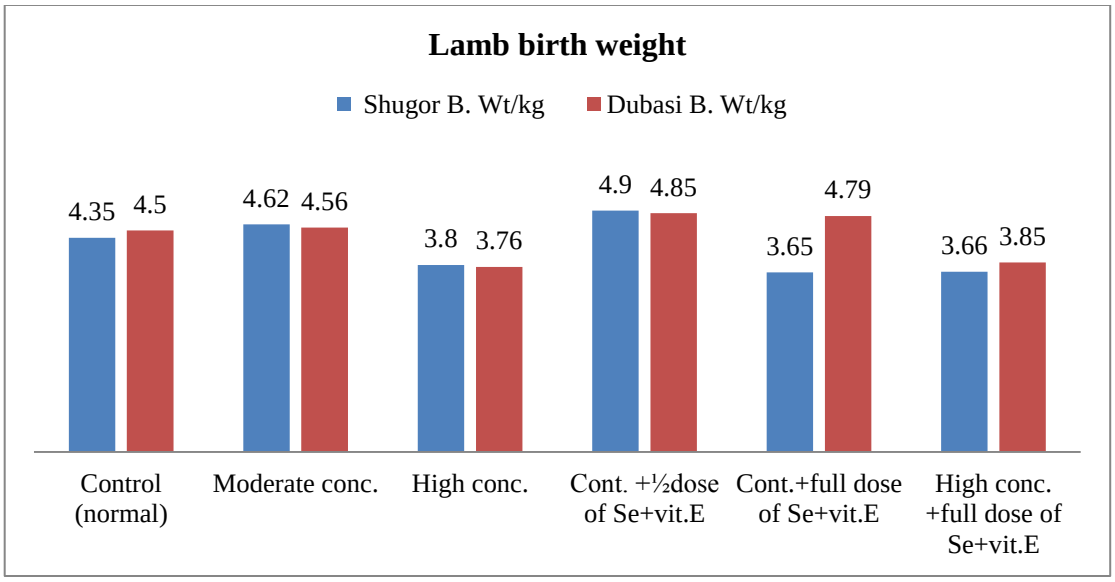

Fig (4.8) shows the influence of flushing and supplementation levels of Selenium and vitamin E on lamb birth weights

Lambs derived from mothers that were administrated with Selenium feast had significantly higher body weight at the age of 30-90days of age compared to the lambs of the mothers not receiving Selenium.

Vitamin E and Se in the diet improved the physiological, hormonal and anti-oxidant status of supplemented sheep (Shakirullah *et al*., 2017) and had the ameliorative potential against toxic effect of arsenic (Roy and Roy, 2017).

4.3 Effects of flushing and supplementation levels of selenium and vitamin E on Haematological parameters:

Table (4.10) summarized the results derived from analysis of variance for the effect of flushing and supplementation levels of Se+vit.E on haematological parameters. The haematological parameters measured were haemoglobin concentration (Hb), White blood cells count (WBCsx10^3/ml), Red blood cells counts (RBCsx10^2/ml) and Packed cell volume (Pcv%).

4.3.1 Effect on Haemoglobin concentration:

The result of this table (4.10) for haemoglobin concentration indicate high significant differences at ($P \leq 0.05$) level for the third month and for all experimental groups for Shugor ecotype. The highest mean value of Haemoglobin concentration for Shugor recorded 10.40 g/dl and 9.98 g/dl for moderate conc. and high concentrate +full dose of Se+vit.E experimental groups, respectively. This result confirms the positive effect of flushing and supplementation of se+vit.E. Dubasi ecotype recorded non-significant difference ($P \geq 0.05$) between all experimental groups. The highest mean value of haemoglobin concentration for Dubasi ecotype recorded 9.90 g/dl and 9.53 g/dl for high concentrate and high concentrate +full dose of Se+vit.E experimental groups, respectively, and also this confirm the positive effect of flushing and supplementation of Se+vit.E on haemoglobin concentration.

Table (4.9) shows the effects of flushing and supplementation levels of Selenium and vitamin E on pre-weaning weights

Period / Treatments	One-month weight (kg)	Two-month weight (kg)	Three-month weight (kg)
Diets	LSM		
Control	12.50[a]	19.49	24.60
Moderate	8.72[b]	13.71	19.94
High	11.55[a]	19.20	25.15
Control+½dose of Se+vit.E	13.01[a]	19.61	25.85
Control +full dose of Se+vit.E	12.20[a]	18.27	24.15
High conc.+full dose of Se+vit.E	11.40[a]	18.25	23.75
Mean	11.56	18.09	24.08
Level of significances	**	Ns	Ns
Breeds:			
Dubasi	11.56	17.48	22.63
Shugor	11.57	18.70	25.53
Level of significances	Ns	Ns	Ns

LSM=Least-square mean, *P≤0.05, **P≤0.01, ***P≤0.001, ns=not significant. Means in the same column followed by the same letter (s) are not significantly different according to Duncan's Multiple Range Test (P≤0.05).

4.3.2 Effects on White blood counts (10^3ml)

The results in table (4.10) indicated high significant difference ($P \leq 0.05$) between all experimental groups, for white blood cells and for both Shugor and Dubasi ecotypes. Strong positive effect was recorded for the flushing and supplementations of Se+vit.E on the production of white blood cells and total leucocyte counts.The highest mean value of white blood cells for Shugor were 17.10 10^3/ml, and 17.11 10^3/ml for high conc. and high conc. + full dose of Se+vit.E experimental groups, while Dubasi recorded 18.60 10^3/ml, 18.13 10^3/ml and 17.89 10^3/ml for moderate, high conc. and high conc. +full dose of Se+vit.E experimental groups, respectively.

The data in this table (4.10) showed that the highest mean values of white blood cells count were recorded for moderate, high conc. and high conc. +full dose of Se+vit.E experimental groups, which confirm the positive effect of flushing and supplementation of Se+vit.E on white blood cells counts.

4.3.3 Effects on Red blood cell counts (RBCs 10^6/ml)

Table (4.10) present results derived from Duncan multiple range test for the effects of flushing and supplementation levels of Se+vit.E on red blood cells counts. In this study Shugor ecotype recorded statistically high significant difference ($P \leq 0.05$) in the second month for all experimental groups. The highest mean values of red blood cells count for Shugor ecotype recorded for moderate, high conc. and high conc. +full dose of Se+vit.E experimental groups and were $8.05x10^6$/ml, $7.31x10^6$/ml and $7.32x10^6$/ml, respectively. Dubasi ecotype recorded non-significant difference ($P>0.05$) between all experimental groups. The highest mean values of $8.05x10^6$/ml, $7.31x10^6$/ml and $7.32x10^6$/ml were recorded for moderate, high conc. and high conc. +full dose of Se+vit.E moderate, high conc. and high conc. +full dose of Se+vit.E experimental groups, respectively, this also confirm the positive effect of flushing and supplementation of Se+vit. E.

Table (4.10) shows the effects of flushing and supplementation levels of Selenium and vitamin E on blood parameters (haematology).

Ecotypes	Periods	Treatments						SEM	Sig. level
		Control	Moderate	High conc.	Cont.+½ dose of Se+vit.E	Cont.+ full dose of Se+vit.E	High+ full dose of Se+vit.E		
		Haemoglobin (g/dl)							
Shugor	0	10.33	9.13	9.60	9.27	9.45	9.34	0.70	NS
	1 month	9.67	8.93	9.70	9.17	9.20	9.32	0.44	NS
	2 month	10.27	9.40	9.60	9.26	9.39	9.78	0.31	NS
	3 month	9.87[ab]	10.40[a]	9.63ab	9.13b	9.10b	9.98a	0.36	*
Dubasi	0	9.93	9.63	9.93	9.40	9.80	9.76	0.54	NS
	1 month	9.53	9.56	9.90	8.57	9.73	9.60	0.51	NS
	2 month	10.10	8.53	9.70	8.73	9.88	9.72	0.51	NS
	3 month	10.17	9.37	9.90	9.23	9.44	9.53	0.47	NS
W.B.Cs x10^3/ml									
Shugor	0	15.47	15.50	15.53	13.30	14.22	15.12	1.51	NS
	1 month	17.30a	13.53b	17.10a	16.53a	17.11a	16.80a	0.89	*
	2 month	12.43b	16.90a	15.77ab	17.00a	16.87a	17.21a	1.30	*
	3 month	13.66	15.80	15.90	13.90	14.13	15.25	2.02	NS
Dubasi	0	10.33b	12.23ab	17.33a	15.33ab	13.87ab	17.47a	1.68	*
	1 month	12.20	16.50	16.03	15.23	14.98	15.08	1.46	NS
	2 month	10.53b	18.60a	18.13a	13.50b	15.33b	17.89a	1.21	*
	3 month	10.17b	15.40ab	17.00a	13.87ab	14.11ab	17.24a	1.67	*
R.B.Cs x10^6/ml									
Shugor	0	6.05	6.27	6.42	5.10	6.11	6.29	0.57	NS
	1 month	6.00	6.81	6.62	5.98	6.32	6.54	0.39	NS
	2 month	6.55ab	7.55a	7.09ab	6.05b	7.06ab	7.62a	0.34	*
	3 month	7.29	8.05	7.31	6.50	7.11	7.32	0.46	NS
Dubasi	0	6.61	6.03	6.95	6.35	6.33	6.70	0.45	NS
	1 month	6.19	7.25	7.13	6.31	6.21	6.66	0.34	NS
	2 month	7.46	6.48	7.58	7.01	7.13	7.65	0.46	NS
	3 month	8.03	7.04	8.07	7.38	7.18	7.76	0.62	NS
Packed cell volume %									
Shugor	0	19.73	20.43	21.00	19.07	20.09	21.11	1.68	NS
	1 month	19.70	22.77	21.93	19.70	21.88	20.71	1.41	NS
	2 month	21.47ab	24.97a	23.07ab	19.40b	22.99ab	25.00a	1.21	*
	3 month	24.30	26.67	24.03	21.00	23.55	25.09	1.80	NS
Dubasi	0	22.03	20.03	22.87	20.97	21.98	22.56	1.78	NS
	1 month	21.70	24.47	24.13	21.57	23.76	25.00	1.33	NS
	2 month	24.93	21.17	25.30	23.23	23.77	25.08	1.78	NS
	3 month	27.07	22.97	27.20	24.97	25.65	26.86	2.27	NS

[a-b] Means within rows with no common superscripts are significantly different. The values in the same row with different superscripts are significantly different (P≤0.05). *: significantly. Cont: Control. Conc.: concentrated feed. Sig: Significant. SEM: Standard error means. NS: no Significant.

4.3.4 Effects on Packed cell volume (PCV%):

Table (4.10) shows the results of analysis of variance for the effect of two flushing systems and three supplementation levels of Se+vit.E. on PCV%. A high significant difference at ($P \leq 0.05$) levels were recorded in the second month for Shugor ecotype for all experimental groups. The highest mean percentage value for PCV% for Shugor ecotype were 26.67%, 24.03% and 25.09% for moderate, high conc. and high conc. +full dose of Se+vit.E experimental groups, respectively. Dubasi recorded non-significant difference ($P \geq 0.05$) between all experimental groups. The highest mean percent values were 27.20%, 27.07% and 26.86% for high conc., control and high conc.+full dose of Se plus vit.E experimental groups, respectively, this result confirm the positive effect of flushing and supplementation of Se+vit.E.

4.4 Effects of flushing and supplementation levels of Se+vit.E on differential white blood cells for both Shugor and Dubasi ecotypes:

4.4.1 Effects on lymphocyte (%):

Table (4.11) summarized the results derived from analysis of variance for the effects of flushing and supplementation levels on the differential white blood cells for both Shugor and Dubasi ecotypes. Results of this table (4.11) indicate statistically high significant difference at ($P \leq 0.05$) level for Dubasi compared to Shugor in control experimental group. Dubasi recorded a mean value of 46.11±5.55% in comparison to 43.87 ± 5.04% for Shugor in control experimental group. All other experimental group recorded approximately similar results without any statistical differences between the two genetic groups (Shugor and Dubasi.)

4.4.2 Effects on Neutrophils (%):

A higher statistical significant difference at (P≤0.05) level was recorded for Neutrophils% in favour of Shugor in control+½dose of Se plus vit.E experimental group. All other experimental groups recorded approximately similar results without any statistical significant difference between them (p≥0.05).

4.4.3 Effect on monocyte:

The monocyte % recorded non-significant differences (P≥0.05) between the genetic groups and for all experimental groups, the mean value of monocytes % ranged between 9.11±0.73 and 5.22 ±0.47 for Shugor, while Dubasi recorded a mean value ranging from 9.32±1.08 and 6.12±0.83% (Table 4.11).

4.4.4 Effects on Basophil (%):

A high significant difference at (P≤0.05) level was recorded for Basophil% for Dubasi in comparison to Shugor in control experimental group. All other experimental groups recorded approximately similar results without any statistical difference between the two genetic groups (P≥0.05). The mean percent of basophil ranged between 0.97±0.07 and 3.22±1.8% in Shugor ecotype in the control diets and high concentrate +full dose of Se+vit.E experimental groups, respectively. Dubasi recorded a mean percent ranging from 1.66±0.27% and 2.99±1.05% for control and high concentrate+full dose of Se+vit.E experimental groups, respectively.

4.4.5 Effects on Eosonophyls (%):

A high statistically significant difference at (P≤0.05) was recorded for Dubasi in moderate and high conc.+full dose of Se+vit.E experimental groups in comparison to Shugor ecotype. All other experimental groups recorded approximately similar results without any statistical difference (P≥0.05). The highest mean values of eosonophyl (%) were recorded in control and high conc. experimental groups and were 5.87±0.93% and

6.32±0.98% for Shugor, while Dubasi recorded 6.55±1.23 and 6.32±0.94 for high conc. and high concentrate +full dose of Se+vit.E diets experimental groups, respectively.

These also confirm the positive effects of flushing and supplementation of Se and vit.E on eosonophils. The results of table (4.11) reflected the positive response of flushing and supplementations of Se+vit.E on increased the total serum globulin level and confirm the beneficial effects in improved immunity state which was highly reflected on serum globulin levels of ewes in both ecotypes.

4.5 Effects of flushing and supplementation levels of Se+vit.E on (Blood Biochemical parameters) serum total protein (Tb), Albumin (Alb), Glucose (mg/dl), and Cholesterol (mg/dl) in Shugor and Dubasi ecotypes.

Table (4.12) summarized the results derived from analysis of variance for the effects of flushing and levels of supplementation of Se+vit.E on serum blood components (biochemical parameters). The biochemical parameters measured in this study were total protein (g/dl), Albumin (g/dl), Glucose (mg/dl), and Cholesterol (mg/dl).

4.5.1 On total protein:

Results of this table (4.12) indicated a high statistical difference ($P \leq 0.05$) in the third month for all experimental groups and for both ecotypes. Dubasi recorded a significantly higher total protein values compared to Shugor ecotype. Dubasi recorded 6.50 g/dl, 6.62 g/dl and 6.65g.dl and 6.42 for high concentrate, control +½dose of Se+vit.E and high concentrate +full does of Se+vit.E experimental groups respectively. Shugor recorded 6.45 g/dl, 6.42 g/dl, 6.58 g/dl, 6.22 g/dl and 6.18 g/dl for moderate concentrate, high concentrate, control+½dose of Se+vit.E, control full of Se+vit.E and high concentrate +full dose of Se +vit.E experimental groups, respectively.

Table (4.11): Shows the Effects of flushing and supplementation levels of Selenium and vitamin E on differential white blood cell counts on Shugor and Dubasi ecotypes

Items	Treatments					
	Control	Moderate	High conc.	Cont.+½ dose of Se+vit.E	Cont.+ full dose of Se+vit.E	High+ full dose of Se+vit.E
	Lymphocytes(%)					
Shugor	43.87±5.04[b]	44.32±5.14	43.11±4.67	41.32±5.08	40.33±4.16	39.38±4.33
Dubasi	46.11±5.55[a]	44.76±5.12	45.65±5.01	41.45±5.00	41.34±4.79	40.21±4.14
Sig	*	NS	NS	NS	NS	NS
Neutrophils (%)						
Shugor	40.52±4.14	40.23±4.08	40.11±3.99	41.44±4.66[a]	42.32±5.01	43.33±5.04
Dubasi	40.60±4.13	40.65±4.45	39.88±3.76	40.22±3.87[b]	41.58±4.22	44.21±5.34
Sig	NS	NS	NS	*	NS	NS
Monocytes (%)						
Shugor	9.11±0.73	8.53±0.61	8.43±0.55	6.87±0.71	5.71±0.44	5.22±0.42
Dubasi	8.86±0.66	9.32±1.08	7.98±1.03	7.54±1.11	6.89±0.73	6.12±0.83
Sig	NS	NS	NS	NS	NS	NS
Basophils (%)						
Shugor	0.97±0.07[b]	1.43±0.17	1.88±0.88	2.00±1.02	2.25±0.99	3.22±1.08
Dubasi	1.66±0.27[a]	1.90±0.57	2.00±0.87	2.11±0.97	2.65±1.02	2.99±1.05
Sig	*	NS	NS	NS	NS	NS
Eosonophyls (%)						
Shugor	5.87±0.93	3.78±0.63[b]	6.32±0.98	4.73±0.73	5.54±0.91	4.33±0.88[b]
Dubasi	5.39±0.75	4.76±1.03[a]	6.55±1.23	5.32±0.87	4.87±0.91	6.32±0.94[a]
Sig	NS	*	NS	NS	NS	*

[a-b] Means within common with no rows superscripts are significantly different.

The values in the same common with different superscripts are significantly different (P≤0.05). *: Significantly.

Sig: Significant. NS: no Significant.

4.5.2 On Albumin (g/dl)

Results of this table (4.12) showed a high statistical difference at (P≤0.05) on Albumin levels between all experimental groups and for both Shugor and Dubasi ecotypes in the third month. In this study the mean values of Albumin were 4.41 g/dl, 4.37 g/dl, 4.36 g/dl, 5.60 g/dl, 5.40 g/dl and 5.52 g/dl for Shugor, while Dubasi recorded 4.33 g/dl, 4.41 g/dl, 4.40 g/dl, 4.45 g/dl, 4.42 g/dl and 4.46 g/dl for control, control +½dose of Se+vit.E and high concentrate diets +full dose of Se+vit.E experimental groups, respectively. The results indicated that Shugor ecotype recorded relatively higher levels of albumin. Albumin is produced only in the liver and is a major plasma protein that circulates in blood stream. Albumin is essential for maintaining the oncotic pressure in vascular system. A decrease in oncotic pressure due to low albumin levels allows fluids to leak out from the interstitial spaces into peritoneal cavity producing scales. Albumin is also important in transportation of many substances such as drug, lipids, hormones and toxins that are bound to albumins blood stream, (Pagana, 2002; Fischbach *et al*., 2004).

4.5.3 On Glucose (mg/dl):

Results in table (4.12) showed a high and statistical significant (P≤0.05) levels for glucose for all experimental groups and for both ecotypes in the third month and for second and third month for Dubasi.

The mean values of glucose were 60.09 mg/dl, 61.11 mg/dl and 60.88 mg/dl, for high concentrate, control+full dose of Se+vit.E and high concentrate+full dose of Se+vit.E while Dubasi recoded 54.98 mg/dl, 54.53 mg/dl, 58.47 mg/dl, 57.99 mg/dl and 59.01mg/dl for control+½dose of Se+vit.E, control+full dose of Se+vit.E and high concentrate +full dose of Se+vit.E diets experimental groups, respectively

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4.5.4 On cholesterol (mg/dl):

Results of Table (4.12) showed strong effects for cholesterol, a high statistically significant (P≤0.05) levels were recorded for two consecutive months for both Shugor and Dubasi ecotypes and for all experimental groups. Shugor recorded a mean value of 45.60 mg/dl, 51.66 mg/dl, 53.52 mg/dl, 55.73 mg/dl, 54.87 mg/dl and 55.7 mg/dl, while Dubasi recorded 53.66 mg/dl, 59.60 mg/dl, 56.47 mg/dl, 55.41 mg/dl 56.41mg/dl and 60.13 mg/dl for control, moderate, high conc., control +½dose of Se+vit.E, control+full dose of Se+vit.E and high concentrate+full dose of Se+vit.E experimental groups, respectively.

4.6 Effects of flushing and supplementation of Se+vit.E on (blood biochemical parameters) Triglycerides, Calcium (g/dl) and phosphorus (g/dl):

4.6.1 On triglycerides:

Table (4.13) summarized the results derived of the effects flushing and supplementation of Se+vit.E on triglycerides levels for both Shugor and Dubasi ecotypes. A high significant effect (P≤0.05) was recorded for Dubasi for three consecutive months for all experimental groups, while Shugor recorded a significant effect (P≤0.05) the first month for all experimental groups. The mean value of triglycerides (mg/dl) for Shugor were 47.67, 44.71, 42.06, 45.78, 44.34 and 45.14, while Dubasi recorded 53.63 mg/dl, 43.88, 56.22, 55.40 53.09 and 56.21 for control, moderate, high conc., control +½dose of Se+vit.E, control+full dose of Se+vit.E and high conc.+full dose of Se+vit.E diets experimental groups, respectively.

4.6.2 On Calcium (g/dl):

Results from table (4.13) showed a high significant difference (P≤0.05) in the three consecutive months for all experimental groups for Dubasi ecotype, while Shugor recorded a high significant difference (P≤0.05) in the first month and for all experimental groups.

Table (4.12): Shows the Effects of flushing and supplementation levels of Selenium and vitamin Eon serum blood components (biochemical parameters).

Ecotypes	Periods	Treatments						SEM	Sig
		Control	Moderate	High conc.	Cont.+½ dose of Se+vit.E	Cont.+ full dose of Se+vit.E	High+ full dose of Se+vit.E		
		Total protein (g/dl)							
Shugor	0	6.19	6.23	6.23	6.15	6.32	6.22	0.07	NS
	1 month	6.23	6.26	6.25	6.23	6.40	6.33	0.12	NS
	2 month	6.32	6.31	6.28	6.42	6.31	6.24	0.16	NS
	3 month	6.25^{b}	6.45^{ab}	6.42^{ab}	6.58^{a}	6.22^{b}	6.18^{b}	0.07	*
Dubasi	0	6.21	6.28	6.29	6.22	6.27	6.29	0.05	NS
	1 month	6.34	6.31	6.30	6.30	6.29	6.31	0.10	NS
	2 month	6.39	6.38	6.34	6.37	6.36	6.30	0.13	NS
	3 month	6.39^{b}	6.50^{b}	6.50^{b}	6.62^{a}	6.40^{b}	6.65^{a}	0.03	*
Albumin (g/dl)									
Shugor	0	4.14	4.21	4.20	4.17	4.19	4.17	0.03	NS
	1 month	4.18	4.23	4.26	4.26	4.24	4.23	0.04	NS
	2 month	4.25	4.29	4.32	4.29	4.28	4.30	0.04	NS
	3 month	4.41^{b}	4.37^{b}	4.36^{b}	5.60^{a}	5.40^{a}	5.52^{a}	0.35	*
Dubasi	0	4.17	4.22	4.24	4.21	4.23	4.22	0.03	NS
	1 month	4.25	4.27	4.28	4.29	4.30	4.27	0.04	NS
	2 month	4.29	4.31	4.36	4.34	4.32	4.30	0.03	NS
	3 month	4.33^{b}	4.41^{a}	4.40^{a}	4.45^{a}	4.42^{a}	4.46^{a}	0.02	*
Glucose (mg/dl)									
Shugor	0	49.92	50.56	48.67	51.54	49.66	50.21	1.26	NS
	1 month	51.45	53.41	51.74	52.55	53.28	53.45	1.69	NS
	2 month	52.15	55.50	55.59	55.59	64.67	55.88	1.36	NS
	3 month	49.80^{b}	56.44^{ab}	60.09^{a}	58.83^{a}	61.11^{a}	60.88^{a}	2.26	*
Dubasi	0	41.15	42.51	41.70	42.47	41.66	42.35	1.69	NS
	1 month	45.95	47.69	46.48	49.62	48.44	49.11	1.12	NS
	2 month	47.59^{b}	52.22^{a}	51.34^{ab}	55.69^{a}	55.77^{a}	56.12^{a}	1.35	*
	3 month	50.88^{c}	54.98^{b}	54.53^{b}	58.47^{a}	57.99^{a}	59.01^{a}	0.89	*
Cholesterol (mg/dl)									
Shugor	0	41.54	42.27	43.04	40.41	42.12	41.67	2.09	NS
	1 month	42.49	44.77	43.58	43.47	44.32	44.51	1.09	NS
	2 month	43.63^{b}	47.53^{ab}	47.58^{ab}	49.59^{a}	50.13^{a}	49.98^{a}	1.37	*
	3 month	45.60^{c}	51.66^{b}	53.52^{ab}	55.73^{a}	54.87^{a}	55.71^{a}	0.83	*
Dubasi	0	46.62	45.73	44.58	45.55	45.32	44.76	0.70	NS
	1 month	49.57	52.48	49.50	48.53	51.31	52.11	0.52	NS
	2 month	51.40^{b}	56.63^{a}	$53.58a^{b}$	52.53^{ab}	56.24^{a}	56.46^{a}	1.25	*
	3 month	53.66^{b}	59.60^{a}	56.47^{ab}	55.41^{b}	56.41^{ab}	60.13^{a}	1.09	*

$^{a-b}$ Means within rows with no common superscripts are significantly different. The values in the same row with different superscripts are significantly different ($P \leq 0.05$). *: significantly. Sig: Significant. SEM: Standard error means. NS: no Significant.

The highest mean values of Calcium (g/dl) recorded for Shugor (1month) were 11.31, 11.12 and 10.11 for control, control+full dose of Se+vit.E and high conc.+full dose of Se+vit.E while Dubasi recorded 10.59, 10.93 and 10.80 for moderate, high concentrate and control +full dose of Se+vit.E experimental groups, respectively.

4.6.3 On phosphorus (g/dl):

Results in table (4.13) for phosphorus showed a high significant difference at ($P \leq 0.05$) for Shugor and for all experimental groups. The highest mean values for three concestive month's phosphorus for Shugor ecotype were 7.25g/dl and 6.96 g/dl for moderate and high concentrate diets experimental groups, respectively. Dubasi ecotype recoded non-significant difference ($P \geq 0.05$) for all experimental groups for phosphorus levels. The highest mean value for phosphorus for Dubasi were 6.53g/dl and 6.57 for control and control+½dose of Se+vit.E diets experimental groups.

4.7 Effects of flushing and supplementation of Se+vit.E on blood components

4.7.1 Effect on total protein (g/dl):

Results of table (4.13) showed a statistically non-significant difference between the two ecotypes groups for all experimental groups. This means that both ecotypes responded in similar manner for all experimental diets.

4.7.2 Effects on Albumin (g/dl):

Both ecotypes (Shugor and Dubasi) showed statistically non-significant difference ($P \geq 0.05$) and reported in the same manner similar results for all experimental diets.

4.7.3 Effects on Glucose:

Results showed no-significant effects between ecotypes and experimental groups.

Table (4.13): Shows the Effects of flushing and supplementation of Selenium and vitamin E on serum blood components (biochemical parameters)

Ecotypes	Periods	Treatments						SEM	Sig
		Control	Moderate	High conc.	Cont.+½ dose of Se+vit.E	Cont.+ full dose of	High+ full dose of		
		Triglyceride (mg/dl)							
Shugor	0	33.37^{ab}	43.35^{ab}	30.91^{b}	53.18^{a}	33.42^{ab}	38.67^{ab}	6.29	*
	1 month	44.98	43.77	47.06	52.36	48.35	46.41	3.30	NS
	2 month	51.76	54.06	58.24	53.25	55.23	56.12	3.71	NS
	3 month	47.67	44.71	42.06	45.78	44.34	45.14	3.29	NS
Dubasi	0	41.89	38.82	47.34	49.79	40.18	39.25	3.56	NS
	1 month	47.59^{ab}	43.75^{b}	54.63^{a}	52.58^{ab}	46.65^{ab}	45.23^{ab}	2.88	*
	2 month	58.49^{a}	53.63^{a}	43.88^{b}	56.22^{a}	49.23^{ab}	53.22^{a}	2.91	*
	3 month	53.63^{a}	43.88^{b}	56.22^{a}	55.40^{a}	53.09^{a}	56.21^{a}	2.70	*
Calcium (g/dl)									
Shugor	0	15.81	15.76	16.08	16.22	15.12	15.77	0.84	NS
	1 month	11.31^{a}	8.26^{b}	10.00^{ab}	9.53^{ab}	11.12^{a}	10.11^{ab}	0.62	*
	2 month	10.65	10.17	9.95	10.55	9.99	10.05	0.49	NS
	3 month	10.22	8.50	9.48	9.56	8.66	9.75	0.70	NS
Dubasi	0	14.34	15.50	13.09	14.98	13.63	14.78	1.46	NS
	1 month	10.16^{ab}	10.59^{ab}	10.93^{a}	9.27^{b}	10.80^{a}	9.30^{ab}	0.45	*
	2 month	10.05^{ab}	9.80^{b}	11.34^{a}	10.58^{ab}	10.23^{ab}	9.54^{b}	0.44	*
	3 month	9.76^{b}	9.26^{b}	10.53^{a}	9.53^{b}	9.23^{b}	9.18^{b}	0.43	*
Phosphorus (g/dl)									
Shugor	0	4.62	5.61	4.94	5.09	5.11	5.34	0.47	NS
	1 month	3.51^{b}	5.25a	3.68^{b}	4.75^{ab}	3.22^{b}	4.31^{ab}	0.45	*
	2 month	4.34^{b}	6.78a	6.06^{ab}	6.42^{ab}	5.33^{ab}	5.21^{ab}	0.62	*
	3 month	5.28^{b}	7.25a	6.96^{a}	5.49^{b}	6.88^{a}	6.22^{a}	0.43	*
Dubasi	0	5.43	4.49	5.36	3.68	4.22	3.99	0.56	NS
	1 month	4.93	4.39	4.75	5.29	4.89	4.31	0.61	NS
	2 month	5.63	4.98	5.59	5.12	5.34	4.97	0.40	NS
	3 month	6.53	6.02	6.22	6.57	5.99	6.07	0.33	NS

$^{a-b}$ Means within rows with no common superscripts are significantly different.

The values in the same row with different superscripts are significantly different ($P \leq 0.05$).

*: significantly

Sig: Significant. SEM: Standard error means. NS: no Significant

4.7.4 Effects on cholesterol (mg/dl):

Result of this table (4.13) recorded high significant difference (P≤0.05) in favour of Dubasi compared to Shugor in control+½dose of Se+vit.E diets experimental group. Other experimental groups recorded approximately similar results without any statistical differences (P≥0.05).

DISCUSSION

Sudan desert sheep are raised under open rangeland and may obtain adequate feed from grazing during rainy season, but are on the verge of starvation during the dry season. Dry season pasture does not meet the maintenance requirements of sheep and may lead to loss of weight and mortality in young animals. Reproductive efficiency of different breeds of sheep inhibiting the semi-arid regions of India is relatively low (Arora and Garg,1998).These strains of sheep however, encounter different nutritional regimens and harsh environment (high ambient temperature, scarcity of feed and water) as compared to that of temperate regions. This harsh environment in turn influences reproduction and limits the increase in population, such environmental conditions (season and nutrition) are also known to influence super-ovulation and embryo transfer program.

Nutrition is one of the environmental cues that affect reproduction in domestic animals (Tatman *et al*., 1990). Direct effects of poor nutrition are reflected in reduced conception, embryonic losses, reduced lambing rate (Diskin and Nisweneder, 1989) and high ewes mortality (Yoder *et al*., 1990). Low lambing rate represent a major obstacles to sheep production (Schoenian and Bufenin, 1990). Lambing rate of 64-70%, have been reported for sheep in Sudan (Mukhtar, 1985). It is, therefore, inevitable for sheep producer in this country to resort to flushing systems and supplementations of trace minerals and vitamins to augment the deficient range resources to meet the requirements of sheep industry.

It is widely accepted practice in sheep production to provide ewes extra energy supply (flushing) for 2-3 weeks prior to and during breeding for the purpose of increasing the number of lambs produced. It is evident that failure to flush ewes may result in delayed oestrus (Gunn *et al*., 1979) fertilization failure (Restal *et al*., 1978), and embryonic mortality (Rhind *et al*., 1989). Rhind (1992) and Gunn (1983) suggested that ovulation rate

depend on short term flushing only in ewes which are within the intermediate range of body condition. It is known that ovulation rate in ewes with moderate body weight condition increase on feeding above their energy requirements (flushing) during the few weeks before mating (Rhind, 1997).

In this study fertility percent of 100%, 133%, 100%, 133% and 133% were recorded for Shugor, while Dubasi recoded 100%, 133%, 100%, 100% and 133%for ewes flushed with moderate concentrate, high concentrate, control (normal concentrate) +½dose of Se+vit.E, control +full dose of Se+vit.E and high concentrate+full dose of Se+vit.E experimental groups, respectively. The results clearly reflected the importance of flushing with energy, protein and Se+vit.E. The control group recorded 67% fertility. These result beside confirming the beneficial effects of flushing and supplementation of Selenium and vitamin E also were in agreement with most reported literature. The result are in line with the results of Pilarczyk *et al* (2004) who found a significant improvement in reproductive indices (fertility 96% and fecundity 137.5%) after application of sodium Se in ewes.

Flushing influences ruminant fertility directly by the supply of specific nutrients required for the process of oocyte and spermatozoa development, ovulation, fertilization, embryo survival and establishment of pregnancy. It also influences fertility indirectly through its impact on the circulation of the hormones and other nutrients sensitive metabolites that are required for the success of these processes. Recently ruminant fertility extends from whole animal response to intricate cellular and molecular events that control gamete production, embryonic and fetal life on the timing of puberty and subsequent adult fertility.

A further dimension to recent nutritional research on ruminant fertility is the identification of feeding strategies that improve the

cryopreservation qualities of spermatozoa in males and super-ovulation response and embryo quality in females involved in multiple ovulations and embryo transfer program. When reviewing the nutritional effects on fertility in small ruminant, Landau and Molle (1997) concluded that for several Mediterranean breeds of sheep, a short term feed supplementation before mating positively influenced ovulation.

Markedly higher fertility of ewes receiving Selenium enriched algae is an interesting finding. An increase in fertility by 38% in Selenium deficient areas after Se. supplementation was reported for a large group, of sheep by Balicka- Ramisz *et al*., (2006). The higher fertility result may be due to the role of flushing in the first stage of pregnancy and also there is a big role for Se and vit,E in protecting the hormones receptors which activate the ovaries and the protection of oxidation in addition to extra release of hormones of estrogen and the activation of Se to the uterus contraction towards oviduct during estrus and this improve the positive move of the semen towards ampullae, this usually resulted in a greater fertility

(Polkowska *et al.*, 2003).

In this study Shugor recorded the highest lamb birth weight ranging from 3.65 kg to 4.9 kg, while Dubasi recoded a lamb birth weight ranging from 3.76 kg to 4.85 kg. The highest lamb birth weight was 4.90 kg which was recorded for Shugor on control+½dose of Se+vit.E experimental group, while high concentrate and high concentrate+full dose of Se+vit.E experimental groups recoded a lower lamb birth weight ranging from 3.80 kg to 3.76 kg and 3.66kg to 3.85 kg for Shugor and Dubasi respectively. This low lamb birth weight was due to the fact that they gave birth to twins. This result is in line with the results reported by Sulieman *et al* (1990), who reported that, the lamb birth weight for Sudan desert sheep at El-Huda research station include Shugor Dubasi and Watish ecotypes were ranging

from 2.5 kg to 4.2 kg. Other workers completely agreed with the former authors (El-Amin and rizgalla 1976; Wilson, 1976 and El-hag *et al* 2001). Also the results were similar to the results reported by Abdelrazig (2005) who stated that Shugor ecotype had the highest birth weight followed by Dubasi and *Watish*. He recorded 3.63±0.06 kg, 3.43±0.05 kg and 3.17±0.04 kg for Shugor, Dubasi and *Watish* ecotypes, respectively.

In this study supplemented ewes had significantly heavier lamb birth weights compared to control group. Reese *et al*., (1990) reported that the energy and supplementations of Selenium and vitamin E, resulted in a significant ($P \leq 0.01$) and positive effect on lamb birth weight. Our results are is in agreement with (Resales *et al*., 1986; Gentry *et al*., 1992; Copper *et al*., 2002) who reported a significant increase in lamb birth weight with increased dietary vitamin E to pregnant ewes. The supplementation of goats with Selenium and vitamin E was significant for kids birth weight with a more positive effect at dose of (0.5 mg/kg Se and 20 mg/kg). Vit. E improved reproductive performances and growth of kids, kids born supplemented with vit.E or vit.E plus Se had significantly higher weaning weights than kids from untreated control. Also in this study, the lambing rate was 67%, 100%, 133%, 100%, 133% and 133% for Shugor, while Dubasi recorded 67%, 100%, 133%, 100%, 100% and 133% for control, moderate, high concentrate, control +½does of Se+vit.E, control+full dose of Se+vit.E and high concentrate+full dose of Se+vit.E experimental groups, respectively. It is evident from table (9) that the ewes fed high concentrate and high concentrate +full dose of Se+vit.E experimental groups, recorded the highest lambing rate.

In this study the litter size recoded 0.67, 1.0, 1.33, 1.0, 1.0 and 1.33for Shugor, while Dubasi recorded 0.67, 1.0, 1.33, 1.0, 1.0 and 1.33 for control, moderate, high concentrate, control+½dose of Se+vit,E, control+full dose of Se+vit.E and high concentrate+full dose of Se+vit.E

experimental groups, respectively. The results confirmed the positive effect of flushing and supplementation of Se and vit. E on litter size. Our results were comparable to litter size reported by Girma (2008) who reported litter size for tropical breeds ranging between 1.08 and 1.75 with an average of 1.38. Solomon *et al*., (2010) reported that the litter size for Ethiopian Washera sheep breed was about 1.11. Sulieman *et al*. (1990) reported a litter size for Shugor, Dubasi and *Watish* of about 1.30, 1.18 and 1.17 respectively. Sulieman and Eissaw, (1984) reported that Shugor had more litter size (1.25) than either Dubasi or *Watish* (1.16) although the differences were not statistically significant. Also our results agreed with Mukhtar and Fadlalla, (1988) who found that supplementary feeding has resulted in 17% increase in lambing percentage and 21% decrease in abortion.

According to Diskin and Niswender, (1989) and Yoder *et al*. (1990) who stated that the effect of pregnancy stress are manifested in increased abortions, weight loss and mortality. The flushed and supplemented ewes on the other hand had lower weight loss, reduced frequency of abortions and recorded non-dead born lambs. The results of this study are in agreement with Suttle, (2010), who reported that deficiency of Se resulted in 20-50% of infertility in females and also increased lamb losses in Newzealand, and Austrilia sheep.

This study was in full agreement with the study of Younis *et al*., (1978) and Degen *et al*., (1987) who reported that under harsher nutritional conditions in semi-arid Southern Mediterranean region, where regular food supply is not guaranteed, lambing and twining rates were shown to be boosted following nutritional flushing (Younis *et al*., 1978; Degen *et al*., 1987) or when live weight of ewes are higher at mating (Thomson and Bahhad, 1988). Other features of the reproductive functions, such as the onset of puberty (Kassem *et al*., 1989) or response to ram effect (Hamidalla

et al., 2000; Thunonier *et al*., 2000) can also be modified through short to medium term dietary changes.

The result of this study for the effect of flushing and supplementations of Se and vit,E on haemotological parameters included haemogolobin concentration (Hb), white blood cells (WBCsx10^3/ml), red blood cells (RBCsx10^6/ml) and packed cell volume (PCV%). The results of this study for haemogolobin concentration indicated significant difference at ($P \leq 0.05$) level for all experimental groups for Shugor ecotype. The highest mean value of haemoglobin concentration for Shugor recorded 9.78 g/dl, 10.40 g/dl and 9.78 g/dl for control, moderate and high concentrate+full dose of Se+vit.E experimental groups, respectively. Dubasi ecotype recorded non-significant difference($P \geq 0.05$) for all experimental groups, the highest mean value of haemogolobin concentration for Dubasi ecotype, recorded 10.17 g/dl, 9.90 g/dl and 9.53 g/dl for concentrate, high concentrate and high concentrate+full dose of Se+vit.E groups, respectively. Results of this study for white blood cells indicated high significant difference ($P \leq 0.05$) for all experimental groups for both Shugor and Dubasi ecotypes. A strong positive effect was recorded for flushing and supplementations of Se plus vit. E on the production of white blood cells and total leucocyte counts (WBCsx10^3/ml). Shugor ecotype recorded 17.30, 13.53, 17.10, 16.53 and 16.80 while Dubasi recorded 10.3, 18.60, 13.50, 15.33 and 17.88 for control, moderate, high concentrate, control+½dose of Se+vit.E, control +full dose of Se+vit.E and high concentrate+full dose of Se+vit.E experimental groups, respectively. The results showed that the highest mean value of white blood cell counts were recorded for moderate, high concentrate and high concentrate+full dose of Se +vit.E experimental groups. The results confirmed the importance of flushing and supplementations of Se plus vit, E in production of increased levels of WBC counts.

Supplementation of Se enhanced the immune globulin levels and may directly improve animal defense mechanism and reproductive performance. This is in line with the findings of Sobiech and Kulela, (2002) who stated that Selenium and vitamin E improved the immunity of the animal (Milad *et al*., 2001). Our results are in full agreement with the results of Soliman *et al*., (2012) who reported an increase in plasma globulins for ewes and their lambs fed a diet supplemented with combined Se and vit.E. Selenium and vit.E injected during late pregnancy of ewes at the level of 10 ml improved passive immune system and colostrum production (Moeini and Jalilian, 2014).

Our results agree with those reported by (Pollock *et al.*, 1994; Hamam and Abou-Zeina, 2007) who found that vitamin E and Selenium together have an important beneficial effect on immunity than administration of Selenium alone, it has been suggested that Selenium can protect immune cells for long time, where as vit.E has immediate effect (Pollock *et al.*, 1994). Another study on buffalo calves indicated that supplementation of Se improved the humoral immune response whereas, vitamin E showed a tendency towards improvement in cell-mediated immune response (Shinde *et al*., 2007). The results of this study were in full agreement with El-shahat and Amu (2011) who reported an increase in W.B.Cs counts and total serum globulin in *Baladi* ewes fed on diet supplemented with 3mg of Se/1kg plus 50mg of vitamin E, 2 weeks before mating until lambing. Such effect explains the significant increase in serum globulin of treated ewes.

Though Se and vit. E are two chemically different compounds with distinct antioxidant properties, they have overlapping functional goal in the biological system (Hamam and Abou-Zeina, 2007) the metabolism of Se is intimately linked to vit. E and both compounds protect cellular membranes against oxidative degeneration and improve the immune-competence and

responsiveness of host (leal *et al*., 2010). A synergic action exists between vit.E and Se resulted in a more powerful beneficial effect on immunoglobulin (Ig G) levels than administration of both alone (Hamam and Abou-Zeina, 2007). Chauhan *et al*. (2016) reported that supplementation of lambs with supra-nutritional levels of Se and vit.E during the 3weeks finishing period improved average dry matter intake and average daily weight gain probably owing to the fact that Se and vit.E are critical constituents of the antioxidant defense system and play an important role in growth through their participation in enzymes and essential enzymes reactions. The ability of Se and vit.E to provide great antioxidant protection against the oxidative stress is attributed to the activity of Glutathione peroxidase (GSH-Px) such enzyme is one of the most vital antioxidants present in the organism. It is associated with the normal functions of immune system and can modulate a chain of reactions that catalyze the formation of prostacyclin, leukotrienes, prostaglandins and Thromboxaes (Halliwel and Gutheridge, 2007).

In this study the biochemical parameters measured were total protein (g/dl), Albumin in g/dl, Glucose (mg/dl), Cholesterol (mg/dl, Triglycerides (mg/dl), Calcium (g/dl) and Phosphorus (g/dl). In this study a high statistical difference at ($P \leq 0.05$) level were recorded for all experimental groups and for both ecotypes for serum protein. Dubasi recoded 6.50 g/dl, 6.50 g/dl, 6.62 g/dl, 6.40g/dl and 6.65g/dl, while Shugor recorded 6.45 g/dl, 6.42 g/dl, 6.58 g/dl, 6.22 g/dl and 6.18 g/dl for moderate, high concentrate, control+½dose of Se+vit.E, control +full dose of Se+vit.E and high concentrate full dose of Se+vit.E experimental groups, respectively. Serum protein values ranging between 6.65 to 6.18g/dl were recorded in this study, and they are in line with the results obtained by Ahmed (2014) who reported that in goats all serum metabolites values were not significantly ($P \geq 0.05$) different from the control.

Albumin produced only in the liver, a major plasma protein that circulates in blood stream. Albumin is essential for maintaining the oncotic pressure in vascular system. Albumin is also important in transporting many substances such as drugs, lipids, hormones and toxins that are bound to albumin in blood stream. A low serum albumin results in poor liver functions. The most common reason for low albumin is the chronic liver failure caused by cirrhosis (Pagana 2006; Fischbach *et al.*, 2004). Results of this study showed a high statistical difference ($P \leq 0.05$) for Albumin between all experimental groups for both Shugor and Dubasi ecotypes.

Also results of this study showed a high significant difference ($P \leq 0.05$) for glucose between all experimental groups for both Shugor and Dubasi ecotypes. The highest mean value for glucose 60.09mg/dl,58.83 mg/dl and 61.67 mg.dl while Dubasi recorded 54.53 mg/dl, 58.47 mg/dl and 59.01 mg.dl for control+½dose of Se+vit.E, control +full dose of Se+vit.E and high concentrate+full dose of Se experimental groups, respectively. Blood glucose source in ruminant are derived principally from gleconeogenic amino acids (Heilman *et al*., 1979), propionate, lactic acid and to lesser extend butyric acid (Coles, 1967). Propionate derived from rumen fermentation is considered to be the major gluconeogenic precussor in the feeds of ruminants (Young *et al*., 1965). In some small ruminants dairy breeds the explanation for increase milk yield could be ascribed to an increase in serum glucose concentration a precursor of lactose and onset constituent of milk, which increase water secretion and consequently milk production (Morsy *et al*., 2011).

Results of this study showed strong positive effects and a high statistical significant difference ($P \leq 0.05$) for cholesterol for two consecutive months between all experimental groups for both Shugor and Dubasi ecotypes. Shugor recorded a mean value ranging from 45.60 mg/dl to 55.73 mg/dl while Dubasi recorded a range of 60.13 mg/dl to 54.60

mg/dl, Cholesterol is a sterol that is present in all animal tissues. Free cholesterol is an integrated component of cell membrane and source of a precursor for steroid hormones such as estrogen and testosterone as well as bile acids (Panel *et al.*, 2005). Park *et al*. (1980) found that concentration of free cholesterol were highest (P≤0.05) for heifers on highest protein 28.2 mg/100ml as compared to lowest protein group (17.9 mg/100ml).

A high significant difference (P≤0.05) was recorded for triglycerides in Dubasi for three consecutive months for all experimental groups, while Shugor recorded a significant difference at (P≤0.05) level in the first month for all experimental groups. The ranges of values of triglycerides were 30.91 mg/dl and 53.18 mg/dl for Shugor, while Dubasi recorded 43.75mg/dl and 58.49 mg/dl. Results of this study showed a high significant difference (P≤0.05) in the first three months for all experimental groups for Dubasi ecotype, while Shugor recorded a high significant difference at (P≤0.05) level in the first month and for all experimental groups.

Results of Calcium (g/dl) showed a high significant difference (P≤0.05) for the three consecutive months for Dubasi, while Shugor recorded a significant difference at (P≤0.05) level for the first month only. The highest mean value of Calcium for Shugor was 11.31 g/dl, while Dubasi recoded 11.34 g/dl. Results of Phosphorus (g/dl) in this study showed a high significant difference (P≤0.05) for the three consecutive months for Shugor, while Dubasi recoded non-significant (P≥o.o5) difference. The highest mean values of phosphorus for Shugor were 7.25 g/dl and 6.96 g/dl for moderate and high concentrate experimental groups, respectively. Dubasi recorded non-significant difference (P≥0.05) for all experimental groups for phosphorus levels. The highest mean value were 6.53g/dl and 6.57 g/dl for control and control+½dose of Se+vit.E experimental groups, respectively.

In general, the flushing and supplementation of Se+vit.E used in this study changed the metabolic profile of treated ewes. It increased blood serum albumin, total protein, glucose, total cholesterol, triglycerides, calcium and phosphorus levels. The increase in these metabolites were associated with improvement in production capabilities, reproduction performance and positive energy balance in sheep and this is in full agreement with Hashem and Zarkouny (2016) who worked on goats.

Conclusions and Recommendations

Conclusions:

The results of this study clearly indicated that flushing and the supplementation of selenium and vitamin E are essential and confirmed to improve ewes reproductive performance in Gezira area.

The flushing and supplementation of Se+vit.E used in this study seemed to have positive effects in improving oestrus, ovulation, conception, improved fertility, lambing rate, litter size, and birth weights. They also resulted in better ewes condition, reduced abortion and improvement minimized pregnancy stresses and decreased ewes mortality.

In general the flushing and supplementation of Se+vit.E used in this study changed the metabolitc-profile of treated ewes. It increased blood serum, albumin, total protein, glucose, total cholesterol, triglycerides, calcium and phosphorus levels. The increase in those metabolites was associated with improvement in production capabilities, reproductive performance and positive energy balance.

To improve Sudan desert sheep (Dubasi and Shugor) productivity in Gezira conditions and similar ecological zones of Sudan, we recommend to flush and supplement breeding ewes and rams with of increased energy+protein levels with (an amount of 250grams of cereal grains and 100grams of oilseed cakes for 45days) and supplement them with 2ml/head Se+vit.E.

Adoption of such practice by farmers, especially oilseed cakes and Sorghum grains needed are available in the Gezira area and the amounts required are small and relatively inexpensive and would improve sheep reproductive performance.

Recommendations:

1. The mineral contents of feeds should be regularity monitored to improve animal healthy growth and productivity.
2. Additional research on timing and duration of flushing and supplementation of Se+vit.E is needed, particularly to assess the feasibility of flushing by other cereal grains and other oil seed cakes.
3. Further studies on ewes flushing and supplementations during lactation and post-weaning nutrition and effects on lamb growth and survival are needed.
4. The state of selenium powder or soluble dose, effects and its protocol of administration need further studies to document its role in improving reproductive efficiency of Sudanese desert sheep.

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Appendix:

Table (2.1): **Average daily weight gains (g) from birth to 120 days of Sudan Desert lambs at El-Huda, Sudan**

Subtype	Weight (kg) at age (days)				Average daily gain(g)for period (days)		
	0	30	90	120	0-30	30-120	0-120
Shugor	3.62	7.7	14.1	16.9	136	101	110
Dubasi	3.47	7.8	13.9	16.3	145	94	107
Watish	3.17	6.9	12.7	15.2	125	91	99

Source: Sulieman *et al*. (1990).

Table (2) The composition of the commercial salt-lick mineral-vit.premix

Items	**Contents**
Vitamin A	175000 IU
Vitamin D_3	35000 IU
Vitamin E	200mg
Phosphorus	3000mg
Calcium	5000mg
Magnesium	500mg
Iodine	60mg
Manganese	500mg
cobalt	60mg
zinc	250mg
Iron	1500mg
Copper	500g
Selenium	25mg
Sodium	37%

Source : ALnajm Aldahabi Co.for salt cubes (Mineral Blocks plus Vit AD_3E)

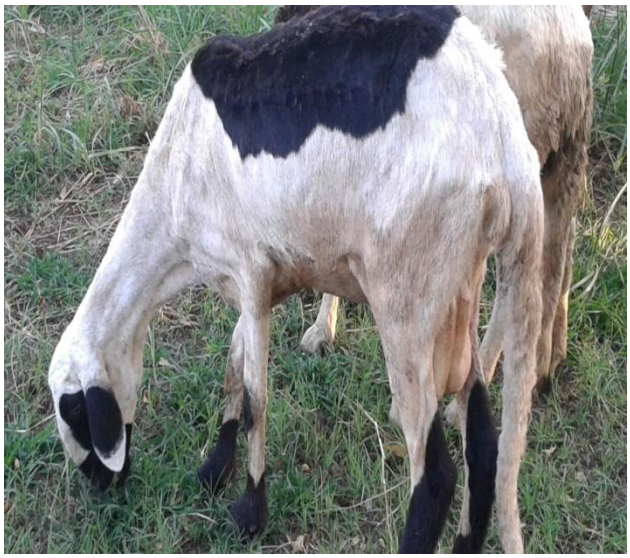
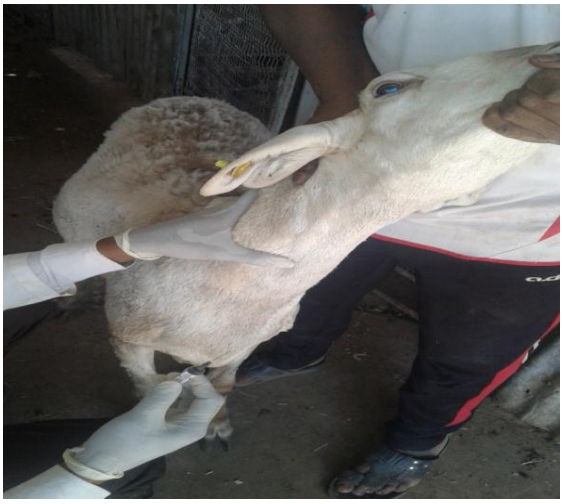


Plate: (1) Housing

Plate (2) Small ruminant's research unit (Faculty of Animal Production)

Late (3): blood sample



Late (4): blood sample