Sudan University of Science and Technology

College of Graduate Studies

EFFECT OF ADDED GRADED LEVELS OF PREBIOTICS IN THE DIET ON PERFORMANCE OF SUDAN DESERT SHEEP

أثر إضافة مستويات متدرجة من البريبايوتك للعليقه فى أداء الضأن الصحراوي السوداني

A thesis Submitted in fulfillment of requirements for the degree of Master of Science (M.Sc.) in Animal Production

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B.Sc. in Animal Production

Sudan University of Science and Technology, 2013

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2017

الآية

قَالَ تَعَالَىٰ:

﴿ وَلِكُلِّ أُمَّةٍ جَعَلْنَا مَنسَكًا لِّيَذْكُرُوا اسْمَ اللَّهِ عَلَىٰ مَا رَزَقَهُم مِّن
بَهِيمَةِ الْأَنْعَامِ ۗ فَإِلَٰهُكُمْ إِلَٰهٌ وَاحِدٌ فَلَهُ أَسْلِمُوا ۗ وَبَشِّرِ الْمُخْبِتِينَ ﴾

سورة الحج: الآية 34

DEDICATION

To my father

To my dear mother who granted me all beautiful things in life

To my brother Wadah ,Rmah and Rbah

To my sister Naba

To my sweetie Saba

To my friends and colleagues

With love.

ACKNOWLEDGEMENT

My gratitude and faithful thanks and praise be to Allah, for providing me health, strength and patience to conduct this study.

My thanks and appreciation to my supervisor Prof. Intisar Yousif Turki for her advices and patient assistance.

My thanks to Dr. Abu bakr Elsaied Ali for his valuable assistance and support through the study period.

All thanks to my friends Dr.Ahmed Elshafee ,Dr. DhiaaEldeen Basher, Dr.Ibrahim Khalid, Ayman Khalid, Mohamed Elfatih. Abdallah Hassan, Abdallah Altaybe, Waheeba Algalie. And all friends for continuous assistance in data collection and printing.

Abstract:-

This study was conducted at research farm unit, College of Animal production, Sudan University of Science and Technology from March to May 2016, to evaluate the effect of added graded levels of prebiotics to the diet on performance of Sudan desert sheep.

The studied performance parameter were dry matter intake, daily weight gain, final body weight and feed conversion ratio, beside effects on immune system in association with hemoglobin concentration, white blood cell and liver's enzymes. Sixteen Sudanese desert lamps of an average body weight (22.5 kg) and average age of 6 month were used in feedlot performance trial for 60 days. Four rations: A (control), B, C and D were formulated; with different levels of prebiotics (0 g/kg, 1g/kg, 1.5 g/kg and 2 g/kg, respectively). The rations were prepared to be iso-caloric and iso-nitrogenous by mixing, sorghum grains, groundnut cakes, groundnut hulls, wheat bran, limestone and salt. The animals were distributed randomly into four experimental groups (A, B, C and D).four lambs in each; and were fed individually their appointed diets. The results showed that, the dry matter intake and final body weight were not significantly (P>0.05) affected by different inclusion rate of prebiotics in the diet. Group B showed the highest daily dry matter intake DMI (1114.91±40.81g/day) and final body weight (39.25±2.22Kg) followed by group C of daily DMI of (1007.7±69.16g/day) and final weight (34.75±2.29kg). The daily body weight gain and feed conversion ratio (FCR) were not significantly (P>0.05) affected by variable levels of prebiotics in the diets. Group B also had the best daily weight gain (283.33±13.61g/day) and FCR of (3.94±0.22) followed by group C which gained daily (204.16±36.96g/day) and improved FCR by (5.02±0.62).

The hemoglobin and white blood cells were not significantly (P> 0.05) affected by different inclusion rate of prebiotics in the diet. Group A showed the highest concentrate of hemoglobin (12.02±4.22g/dl) followed by group B (10.78±2.74mg/dl). Group B showed the highest concentrate of white blood cells WBCs (11885.17±780.20) followed by group A (10714.28±681.86).

The Asparatate aminotransferase (AST) is not significantly (P> 0.05) affected by different inclusion rate of prebiotics in the diet. Group C showed the highest concentrate of Asparatate aminotransferase (250.92±23.08mg/dl) followed by group D (243.45±13.09mg/dl). The Alanin Aminotransferase (ALT) is not significantly (P> 0.05) affected by different inclusion rates of prebiotics in the diet. Group A showed the highest concentrate of Alanin Aminotransferase (50.28±11.12gm/dl) followed by group D (41±15.34gm/dl). The study concluded that addition of prebiotics can improve the overall performance of the lambs. Yet this may be dependent on several factors, such as quantity and level of prebiotics used and other managerial and environmental condition.

مستخلص البحث

أجريت هذه التجربة بمزرعة كلية الإنتاج الحيواني ، بجامعة السودان للعلوم والتكنولوجيا. في الفترة من مارس الي مايو 2016 لمعرفة تأثير إضافة البريبايوتك علي أداء الضأن الصحراوي السوداني (كمية العلف المستهلك ،كسب الوزن اليومي، الوزن النهائي المكتسب ومعدل التحويل الغذائي).وأيضا معرفة تأثير إضافة البريبايوتك علي الجهاز المناعي للأغنام علي ارتباط معدل تركيز الهيموغلوبين، كريات الدم البيضاء وإنزيمات الكبد. تم اختيار عدد ستة عشر رأس من الضأن الصحراوي (16) بمتوسط وزن (22.5 كجم) ومتوسط عمر 6 شهور وقسمت عشوائيا إلي أربع مجموعات كل مجموعه بها عدد اربعه رأس من الأغنام روعي فيها التجانس ما امكن من حيث الوزن والعمر ، ثم وزعت عشوائيا إلي اربع معاملات ، المجموعة الأولي استخدمت كشاهد (كنترول) قدمت لها العليقة (أ) وهي خاليه من البريبايوتك ، المجموعة الثانية تحتوي علي 1 جم بريبايوتك / كجم عليقه ، المجموعة الثالثة تحتوي علي 1.5 جم بريبايوتك / كجم و المجموعة الرابعة تحتوي علي 2 جم بريبايوتك/ كجم تحتوي التركيبة العلفية علي ذره رفيعة (فتريته)، أمباز فول سوداني، ردة قمح، قشرة فول، حجر جيري وملح طعام . روعي في العليقة خلط المواد العلفية بصوره جيده حتي تتوزع كل المواد بصوره جيده في التركيبة. ومن ثم تم تقديم العليقة بصوره متاحه للحيوان طوال فترة التجربة (60 يوم) .دلت النتائج علي أنه لا توجد فروق معنويه بمعدل (0.05) في كمية العلف المستهلك ومعدل الوزن المكتسب بين المجموعات المختلفة مع ملاحظة أن المجموعة الثانية سجلت أعلي قراءه من حيث العلف المستهلك (1114.91±40.81جم/ اليوم) وأعلي وزن حي (39.25±2.22 كجم) مقارنه بالمجموعة الثالثة التي سجلت أدني قراءه من حيث العلف المستهلك (1007.7±69.16جم/ اليوم) ووزن حي (34.75.2±كجم).أيضا دلت النتائج علي عدم وجود فرق معنوي بمعنويه ($p>0.05$) في كل من الوزن المكتسب ومعدل التحويل الغذائي بين مجموعات التجربة المختلفة مع العلم بأن المجموعة الثانية سجلت أعلي معدل تحويل غذائي (3.94±0.22) وأعلي معدل وزن مكتسب (283.33±13.61جم/ اليوم) مقارنه بالمجموعة الثالثة التي سجلت أقل معدل تحويل غذائي (5.02±0.62) ووزن مكتسب (204±36.96 جم / اليوم).فيما يتعلق بالتركيب الكيميائي للدم دلت النتائج علي انه لا توجد فروق معنويه (0.05) بين مجموعات التجربة في تركيز كل من الهيموغلوبين ،كريات الدم البيضاء وإنزيمات الكبد حيث سجلت المجموعة الأولي أعلي تركيز من الهيموغلوبين (12.02±4.22) مقارنه بالمجموعةالثانية التي سجلت أقل تركيز(10.78±2.74). وسجلت المجموعة الثانية أعلي تركيز لكريات الدم البيضاء

(11885.17±780.20) مقارنه بالمجموعة الأولي التي سجلت أقل تركيز (681.86±10714) . بينما سجلت المجموعة الثالثة أعلي تركيز لإنزيم الكبد (AST 278.68±20.25mg\dl) مقارنه بالمجموعة الرابعة التي سجلت أدني تركيز (AST 243.45±13.09 mg\dl) .سجلت المجموعة الاولي أعلي تركيز لإنزيم الكبد (ALT 50.28±11.12 mg\dl) مقارنه بالمجموعةالرابعة التي سجلت أقل تركيز من ALT) (41±15.34 mg\dl ولم يتم رصد فروقات معنوية (p>0.05) بين متوسطات قيم تركيز إنزيم الكبد.

خلصت التجربة الي ان اضافة البريبايوتك الي العلائق تؤدي الي تحسين الاداء العام للضأن بالإضافة الي بعض العوامل التي تؤدي الي تفاوت في نتائج و يجب ان تخضع الي مزيد من الدارسة كنوعية و مستويات الخمائل المضافة و العوامل البيئية الأخرى

List of contents

Chapter Three

List of tables

Chapter One

Introduction

Animal resources are one of the major wealth of economy backbone of several developing countries beside the agricultural products. In this context Sudan needs efforts to develop this section to increase the national income. In Sudan nomadic people raised most population of the sheep under an extensive system where there are few practices of most of the modern scientific techniques. In the past decades the nomads reared their animals including cattle, sheep and goat according to the availability of pasture and water (Ockerman and Abdelrahman, 1985), but now-a-days the nomads tend to rear their animals on the agricultural by-products of private schemes or that purchased from farmers to give their animals a sustainable supply of feed. Range lands in Sudan are characterized by many different plant species due to action and interaction of many factors such as soil, climate, land scape and predominant human activities. In spite of degradation resulting from overgrazing, drought, fire and desertification, they still provide 82.6% of the livestock feed (Daragge and Fadl ELMula, 1994).

The nutrition of sheep is the most important factor affecting performance. Poor nutrition results in low rates of production, often defined by growth and reproduction. It also affects the immune system and the ability of an animal to resist diseases. In extreme conditions of malnutrition, death can occur. In many animal production systems, approximately two-third of improvements in livestock productivity can be attributed to improved nutrition. In economic terms, feed cost accounts about 70% of the total cost of livestock production. The feasibility of livestock enterprises is, therefore a function of the type of feed and feeding system. It is estimated that up to a five-fold increase in tropical livestock productivity can be attained if there is optimal feed resource utilization (Alemu, 2008).

Prebiotics as new additives are substances that can promote the growth of beneficial microorganisms, mainly in the intestinal tract, and will modify the colonic micro biota. The following health benefits are attributed to prebiotics relief from poor digestion of lactose, increased resistance to bacterial infection, better immune response and possible protection against cancer, reduction of the risk of diseases such as intestinal disease, cardiovascular disease, non-insulin dependent diabetes, obesity and osteoporosis (Gibson and Roberfroid, 1995).

Prebiotics are defined as non-digestible food ingredients that selectively stimulate the growth and/or the metabolism of health-promoting bacteria in the intestinal tract, thus improving an organism's intestinal balance (Gibson and Roberfroid, 1995). The health-promoting bacteria most commonly augmented by prebiotics include those of the genus *Lactobacillus* and *Bifidobacter*, which tend to limit the presence of harmful bacteria. Examples of prebiotics include manna oligosaccharides, lactose, galacto-gluco-mannans, oligofructose, and inulin. Many of these prebiotics are carbohydrates, primarily short-chain oligosaccharides consisting of three to ten carbohydrate units, which are derived from various plants or cell wall components of yeast. A commercial product that possesses prebiotics properties is the yeast-based product Prebiotics, which is a mixture of partially autolysis brewer's yeast, dairy ingredient components, and dried fermentation products as noticed by the previous author. The various prebiotics compounds are generally not altered by diet processing and require limited regulatory approval, making their use much simpler than using drugs or chemical therapeutic agents.

Objectives:-

To study the effect of added different levels of prebiotics in the diet on some feedlot performance characteristics and immune system response of Sudan desert sheep.

Chapter Two

2- Literature review

2:1 Sheep population and distribution:-

According to Ministry of Animal Resources, Fisheries and Ranges (MARFR, 2016) sheep population in Sudan is about 40.6 million, representing 37.73 % of the total Sudanese livestock population which is approximately 107.6 million heads. In recent years, Sudanese sheep namely the desert type, have received great interest as an export commodity to the Arab countries. Desert sheep are one of the most distributed sheep types in Sudan spread across the low rainfall savannah, semi desert and desert zones. It is well adapted to arid and semiarid environments and can live in harsh conditions such as water scarcity, poor range grasses and high ambient temperature.

Sheep are ruminants which have the ability to consume and digest coarse, fibrous feedstuffs that form the major feed base in the world. The digestive tract of ruminants is unique in structure and function, allowing them to digest the fibrous feeds they consume. Following are some of the unique features of the ruminant digestive tract compared to mono-gastric animals with a simple stomach such as swine, dogs, cats, and humans according to, Alemu, (2008).

- Ability to digest carbohydrate sources not digested by mono-gastric.

- Ability to use sources of non-protein nitrogen (NPN) to satisfy part of their protein needs.

- Large stomach volume to accommodate and utilize bulky feeds.

- Mouth and teeth well adapted for apprehension and grinding of fibrous feeds.

- Well-developed salivary glands for production of large volumes of saliva.

2:2 Classifications of Sheep:

2.2.1 Classification of sheep in the world

According to the production type sheep are categorized into four groups (El-Khashab, 1997).

2.2.1.1 Meat sheep type

This breed is described by production of meat such as Oxford and Suffolk which records 100-130 kg at maturity age for males and 70-90 kg for female weigh.

2.2.1.2 Milk sheep type

This type is characterized by producing milk, e.g. Italian Lacoune breed. This breed is notable by its milking yield with average production of 211 litters in 165 days lactation period (Ibrahim, 1999).

2.2.1.3 Wool sheep type

This type is well-known by producing good quality of wool such as Merino. This breed has been adapted to Australia for nearly two centuries and it is well appropriate to generate excellent quality wool in semi-arid and arid areas (Carles, 1983).

2.2.1.4 Dual purpose sheep type

This type is considered to be resistant to environmental circumstances and characterized by low productivity compared with the other types. Caloia and Mondero are examples of this type. Both breeds are described by producing meat, milk and wool (Carles, 1983).

2.2.2: Classification of Sudanese sheep

Sheep provide meat for local consumption in addition to their share in national income through the export. Sheep are also reared for milk production. The breeds of sheep in the Sudan and South Sudan were classified into five basic types and three mixed ecotypes according to tail size (Mason and Maule, 1960), the basic types include:-

(1) Sudan desert sheep which include (Butana Gezira, Watish, Hamari, Kababish, Meidob, North River wooled, and Beja).

(2) Sudan Nilotic sheep which include (Dinka, Shilluk, Nuba mountains and Mangala).

(3) Arid upland (Zaghawa sheep).

(4) Arid Equatorial (Taposa and fullani).

(5) Western African Fullani (Fellata and M'Bororo), (Mcleroy, 1961).

2:3 Sudan Desert Sheep :-

Sudan desert sheep are reared strictly within the semi-desert belt of the Sudan, in association with camels. They are owned exclusively by nomadic tribes in the region. Because of their nomadic existence their origin has been difficult to trace (Mufarrih, 1991).

Wilson (1991) mentioned, this Arab type of sheep, presumably owned by these tribes, is woolly coat and short legs, could not have endured the stress of intensive solar radiation and prolonged migration in search of grazing and water and sudden attacks by the enemy. Ellamin and Suleiman, (1983) added, to obtain and animal which would satisfy these requirement, while retaining the desirable characteristics of their original sheep, Arab tribes might have decided to cross-breed their sheep with other types which possessed the required traits. Muffarih, (1991) noticed, Sudan desert sheep, however, posses' a thicker tail and fuller rump. These valuable characteristics might be attributed to partial inheritance from their Asian ancestors.

2.3.1 Ecological habitat of Sudan desert sheep:-

2.3.1.1 Kordfan region:-

The total population of the region according to 1993 census is 3.1 million. Out of this number the urban communities account for 13%, the nomads for 24%and the rural settles for 63 % (Farah 2006).

The soils of the region vary from sandy types at the north to the fertile light and cracking clays at the south. Both sandy and clays Pedi plains occupy to the traditional productive areas constituting above 65% of the total available lands. Shallow soils are confined to the mountainous areas, while loamy and alluvial deposits are limited to the Wade bottoms (Farah, 2006).

The region has wide range of climate zone which range from north to south as fallows and given by (Farah, 2006).

a- Desert type, with rainfall below 100mm

b- Semi-desert, with rainfall varying between 100-225mm.

c- Arid zone, with annual rainfall ranging from 225-400mm.

d- Semi- arid zone, with annual rainfall 400-700mm.

e- Dry wind zone, with annual rainfall raining between 600-800mm.

The basement complex is the oldest and the most extensive rock unit covering more than 50% of the total area of the region. The Nubian sand stone formation occupies some 25% of the total area. The Um Ruwaba sediments fill the major trough of Bara and Beggars basing. The sources of water in the region are itemized as surface water and ground water. The mean annual rainfall in kordofan ranges from 500-850mm, with availability ranging from 18% in the north to 100% in the south. This corresponds to a total amount of rain water of some $150 * 10^6 m^3$/ annum. This water falls in three months between July and September (Farah, 2006).

2.3.1.2 Gazira region:-

Gezira (Eljazirah) is a well populated area suitable for agriculture .the area was at the southern end of Nubian and little is known about its ancient history and only limited archaeological work has been conducted in this area. The region has benefited from the Gezira scheme, a program to foster cotton farming begun in 1925. At that time the Sennar dam and numerous irrigation canals were built Eljazirah became the Sudan's major agricultural region with more than 2.5 million acres (10.000 km) under cultivation. The initial development project was semi-private, but the government nationalized it in 1950. Cotton production increased in the 1970 but by the 1990 increased wheat production has supplanted a third of the land formerly seeded with cotton (Wikipedia, 2014).

2.3.1.3Butana region:-

The area composed of mountainous intersecting the plain to the western borders it crossed by many seasonal rivers namely Atbara Steatite Ba_salam Gash and Rahad rivers .small temporary seasonal valleys do run through these plains during the rainy season. Eastern and western regions and dark cracking clay in the south as a result of this and with the exception of small water catch as mentioned before, very limited water resources are available seasonal, shallow surface water wells are present as well as few very deep bore wells however, the amount of water and the persistence of reserves during the summer dry season depend on the quantity of rainfall during the wet season .In the Butane ,a tropical continental climate prevails ranging from a subequatorial condition with rain in the south to desert climate in the north. Most of the rains are in the form of showers or thunderstorms,(Hussine, 2012), (Darosa and Agab, 2013).

2:3:2 Husbandry methods of Sudan desert sheep:-

The fast-majority of Sudan desert sheep exist under migratory range conditions while a few small flocks exist under a semi-residential system.

The pattern of management adopted in the whole region is essentially the same. Usual size of a flock in traditional desert sheep range land is 250-500 ewes. It has been realized, however, that larger flocks create herding difficulties and lessen the lambing rate. The time of grazing varies between seasons. In dry season most of the grazing is done at night. The herders are aware of the benefit of night grazing in lessening water requirement and avoiding the stress of the solar heat. They firmly believe in a local saying which states that “the ewe is like rabbit. When it grazes at night and lies in the shade during the day, it will produce twins and triple lambs. It has been widely recognized that exposure to high ambient temperatures reduces fertility of rams (Mufarrih, 1991).

In the rain season the availability of drinking water and succulent grazing enables sheep to ingest their daily requirement in a few hours. Because of the mild temperature and frequent cloud, the sheep will continue to graze and lie down in the open air until late in the afternoon.

Rainy season grazing is restricted to the period from 09:00 hours to about 16:00 hours when the plant are without dew. Diseases such as foot rot and nematode infestation are known to result from grazing at night or early morning while the grasses are cold and damp. Salt is supplied in sufficient amounts for free choice nibbling once or twice a week in winter and during the rainy season. During the hot and dry season salting is reduced to minimum to avoid increased water requirement. Sometimes salt is dissolved in drinking water so that each individual animal takes an adequate amount while drinking (Ellamin and Suliman, 1983).

2:3:3 Sudan desert sheep production performance:-

Under tropical environmental conditions, sheep are raised primarily for meat, although milk is also of importance. The value of breeding ewes is determinate by the quantity and quality of lamb or mutton produced and the length of its productive life .Filed collected data on the lambing rate of Sudan desert sheep indicate wide differences between localities presumably attributable to climate, nutritional and management factors. Personally acquired information on migratory groups in the Western Kordofan and Eastern Darfur areas indicated a 150 -170 percent lambing rate, reported the lambing rate for a nomadic flock of Sudan desert sheep in southern Darfur province reported to be 146 percent.

Wide differences in lambing rates also exist among individual flocks under a semi residential system maintained in irrigated areas. Under a residential system, an overall lambing rate of 119 percent and a rate of 125 percent for the Shugur variety alone are reported. This subnormal rate can be probably attributed to the low nutritional level experienced by sheep for a considerable portion of the year (Muffarih, 1991).

El Hag et al, (1998) reported, the nutritional limitation, low nutritive value of the range, high ambient temperature, scarcity of feed and water have great effect on the production of the sheep in semi-arid area of Kordofan state as compared to that in temperate regions.

2:4 Structure of the ruminant stomach:-

The structure of the ruminant stomach was described by Alemu, (2008); as-follows: the ruminant stomach has four compartments known as the rumen, reticulum, omasum and abomasums. Most fermentation and absorption takes place in the rumen and reticulum. The two organs are generally considered as a single organ (reticulo-rumen) due to in complete separation. The reticulo-rumen is like a large fermentation vat where much of the physical and chemical breakdown of fibrous material occurs. Most of the chemical breakdown is a result of enzymatic activity of micro-organisms comprised of bacteria, protozoa and fungi. Physical breakdown is due to the strong movements of the reticulo-rumen and through rumination. The rate at which digestion occurs is governed, to a large extent, by the number and type of microorganisms present in the reticulo-rumen. A large and healthy population of microorganisms' results in faster digestion of feed and an added source of protein for the animal as the microorganisms are broken down and digested later in the abomasums and small intestine. The population of microorganisms is specific to particular diets and changes gradually in response to the type of feed eaten. The rumen can become upset when a sudden dietary change occurs because the micro-organisms cannot effectively digest the new feed. The sudden introduction of a new feed can lead to scouring, loss of condition or even death in severe cases.

2.4.1 Modification of Ruminant Digestive System:-

Rumens-reticulum is the main digesting environment in ruminating animals and both microbial and animals own enzymes and chemicals work together to digest feeds and synthesize new nutrients and other substances. One of the nutrients that ruminal microorganisms digest is cellulose and its bound complexes with other substances. However, microbes and, therefore, rumen environment have limited capacity to digest cellulose substances compared to other polysaccharides such as starch or proteins. Therefore, manipulating ruminal microorganisms and the relative population of certain species might help to increase the digestibility of high woody plants or low quality feeds In fact, ruminal fermentation is a complex system and manipulation may not always be successful although other variables of the ecosystem are closely controlled. Presumably, manipulation of the rumen system can be achieved by feed manipulation, host animal manipulation, and microbial manipulation (Nagaraja 2012). So many attempts in biotechnology have been made to manipulate the rumen environment. Since microorganisms utilize the major nutrients of plants, such as cell wall polysaccharides, their efficiency is considered manipulable. Basically, four groups of microorganisms occupy the rumen, including bacteria, methanogens, protozoa, and fungi giving one or a couple of them a chance to grow better, or in other words, decreasing the number of one or couple of them was the initial thoughts of manipulation as described by the previous anther. Lactate utilizing bacteria inoculation in rumen system had a best fit for animals prone to acidosis and such products called probiotics are produced after microbial fermentation commercially in ferment (DiLorenzo 2011).

Rumen's ability to utilize ingested materials depends highly on how well the fermentation is constructed and how efficiently the products are removed. Some ways of manipulating rumen environment includes reduction of lactic acidosis and methanogenesis, enhancement of acetic, conjugated linoleic, or propionic acid production, manipulation of protein and fat degradation, improvement of microbial protein synthesis and elimination of undesirable microorganisms such as protozoa and end products (Scheire and Tamminga 1996).

Rumen protozoa being larger than bacteria occupy more volume than bacteria with less numbers per gram of fluid (103–106 cells/g).

McAllister et al, (2006) mentioned their symbiotic living with methanogenesis and, therefore, decreasing ruminal protein metabolism Finlay et al, (1994) reported attempts were made to decrease or get rid of ruminal protozoa. Like protozoa, yeast cells involved in plant cell wall digestion and may occupy 8 % of the rumen biomass. Methanogens attracted attention previously only for the loss of energy from the ruminant currently. Because of global warming, attempts towards reducing methane emission by culturing and trying to decrease their growth were made (Hristov et al. 2003).

Additionally, mycoplasmas and bacteriophages are natural residents of the rumen and may share their functions with other living organisms (McAllister et al. 2006).

Based on the fact that most gram-positive microorganisms are lactate producers, ionophore antibiotics are used to change their membrane ion exchange barrier with their highly lipophylic activity. Since gram-negative bacteria have some large membrane molecules to resist ionophore actions, propionate to acetate ratio increases, and propionate used as energy source improves the performance. Ionophore antibiotics indirectly reduce ammonia accumulation and both methane emission and therefore protein efficiency are improved and energy loss is restricted (DiLorenzo, 2011). However, public concern towards feed additive antibiotics claiming that they transfer the antibiotic resistance gene to human microbiota resulted in banning the use of those ionospheres in animal feeds (Gaggia et al. 2010).

According to Beauchemin et al, (2006) and Nagaraja (2012), in rumen there are several types of microorganisms actively involved in the digestion of fibrous, starchy, protein parts of the feeds and anti nutritive substances that bind the minerals and other nutrients by their exogenous enzymes The attempt to improve this enzyme activity has focused on three areas: first, the relative increase in the population of certain bacteria depending on the ingested materials, second determining the genes responsible for synthesizing those enzymes and manipulating them, and third, the addition of exogenous enzymes before the material is ingested. As mentioned earlier, manipulating the feed and animal has attracted less attention than manipulating the ruminal microorganisms and several ways have been attempted other than sub therapeutic antibiotics, including enzymes, direct fed microbial (DFM), or probiotics, prebiotics, and some plant extracts.

2:4:2 Development of the ruminant stomach:-

Alemu, (2008). New born ruminants have only a partially developed rumen and reticulum and are functionally monogastric animals. They are unable to use ordinary carbohydrates except lactose (the carbohydrate in milk) or grain based feeds. Milk is digested in a well-developed abomasums. Milk passes the rumen and goes directly into the abomasums through the "esophageal groove," a tube formed from two folds of muscular tissue in the rumen that close upon suckling action of the lamb/kid. Digestive problems will result if the newborn is weak and unable to suckle.

Dry feed must be consumed for the rumen to develop the rumen becomes inoculated with micro-organisms when the lambs/kids nibble on dry feedstuff. The development of the stomach complex enables lambs/kids to benefit from the action of the microorganisms. Then they have the capacity of:-

1- Microbial digestion of cellulose.
2- Incorporation of non-protein nitrogen into microbial protein and synthesis of vitamin K and the B vitamins. Ideally, the young animal should be confined and, from 2 to 3 weeks of age, supplied with a small amount of easily digestible feed. This will promote faster rumen development. The lamb/kid will increase its feed intake as the milk supply from the dam gradually decreases. Lambs and kids are very vulnerable to malnutrition. Weaning is a critical time unless they are adapted to consuming solid feed and weaned to high-quality diet.

2:4:3 Manipulation of rumen fermentation:-

As indicated by Alemu, (2008), the fermentation process in the rumen can be manipulated to improve the utilization of feed by sheep by:

A- Increasing the digestibility of complex carbohydrates in poor quality roughages.

B- Altering the composition of microbial fermentation products (volatile fatty acids).

C- Decreasing the degradation of certain nutrients in the rumen and encouraging nutrient bypass.

Furthermore he added there are different ways of manipulating fermentation of feeds in the reticulo-rumen. Methods that have the largest effect on ruminal fermentation include the following:-

A- Chopping: Results in increased digestibility largely because it increases the ease with which microbes can attack feed particles. Digestibility will be reduced if chopping is too fine. Finely chopped feeds may pass out of the rumen before microbes can adequately digest them.

B- Heat treatment: The effect of heat treatment depends on treatment conditions. Mild treatment can be used to increase bypass protein. High or moderate temperature treatment for a long time results in reduction of nutritive value, largely due to formation of insoluble protein complexes.

C- Chemical treatment**:** Protection of proteins (e.g., formaldehyde treatment of high quality proteins) is used to increase bypass protein for high producing animals. Digestion of structural carbohydrates can be increased by chemical treatment of poor quality hay and straws (e.g., alkali treatment, urea treatment).

2:5 Feed additives:-

According to Agriculture and Horticulture Development Board (AHDB 2014). Feed additives are products used in animal nutrition to improve the quality of feed and the quality of food from animal origin, or to improve the animals' performance and health.

They are categorized as follows:-

1- Technological additives as preservatives, antioxidants, emulsifiers, stabilizing agents, acidity regulators, silage additives Sensory additives as. Flavors and colorants.
2- Nutritional additives (e.g. vitamins, minerals, amino acids, trace elements)
3- Zootechnical additives (e.g. digestibility enhancers, gut flora stabilizers)
4- Coccidiostats and histomonostats (additives used in poultry diets for health reasons.

Their suggested mode of action varies, but in general, they aim to manipulate the rumen fermentation environment to achieve greater efficiencies.

This range of feed additives has potential to deliver the following improvements in ruminant nutrition:-

1. Increase feed conversion ratio (FCR) and productivity
2. Stabilize rumen pH to reduce acidosis risk
3. Increase dry matter intake (DMI)
4. Reduce methanogenesis
5. Enhance rumen development
6. Reduce pathogen load and shedding
7. Improve meat quality
8. Enhance rumen stability during dietary transitions
9. Buffer against dietary health risks (e.g. mycotoxins).

2:6 Prebiotics:-

According to Gibson and Roberfroid, (1995). Prebiotics are defined as non digestible but fermentable food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon. Prebiotics are non digestible substances that provide a beneficial physiological effect on the host by selectively stimulating the favorable growth or activity of a limited number of indigenous bacteria (Vandana, et al 2013).

Also, Glenn and Marcel, (1995) introduced the prebiotics concept, and defined a prebiotics as a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/ or activity of one or a limited number of bacteria in the colon, and thus improves host health. Although this original definition has been revised multiple times, the main features have mostly been retained.

Prebiotics are short chain carbohydrates that are non-digestible by digestive enzymes in humans and selectively enhance the activity of some groups of beneficial bacteria. In the intestine, prebiotics are fermented by beneficial bacteria to produce short chain fatty acids. Prebiotics also render many other health benefits in the large intestine such as reduction of cancer risk and increase calcium and magnesium absorption. Prebiotics are found in several vegetables and fruits and are considered functional food components which present significant technological advantages. Their addition improves sensory characteristics such as taste and texture, and enhances the stability of foams; emulsions and mouth feel in a large range of food applications like dairy products and bread. This contribution reviews bio-actives from food sources with prebiotics properties. In addition, food application of bioactive prebiotics, stimulation of the viability of prebiotics, health benefits, epidemiological studies, and safety concerns of prebiotics are also reviewed (Sadeq et al, 2013).

In part to account for these new observations, Bird et al, (2010). And Bindels et al (2015) proposed a broader definition for prebiotics, further suggested that prebiotics should be viewed as 'undigested dietary carbohydrates' that are fermented by colonic bacteria yielding short chain fatty acids as end products. Animals can be seriously impacted by bacterial pathogens that affect their growth efficiency and overall health, as well as food safety. Some pathogenic bacteria, such as *Salmonella*, can be a shared problem for both human and animal health, and can be found in many animal species. The intestinal microbial population of animals is very dense and highly diverse (Zoetendal et al, 2006). More than 2000 bacterial species are known and populations10^{10} cells/g digest are not uncommon

(Hungate 1966). As the animal matures, there is a succession of species that colonize the gut and this population slowly increases in complexity, until a stable population becomes fully established (Lu et al, 2003). A fully-mature ecosystem occupies all environmental niches and utilizes nearly all available nutrients, which tends to exclude pathogenic bacteria from the complex gastrointestinal microbial population.

Utilization of this native or artificially-introduced micro flora population to improve animal health and productivity has been termed a probiotic, or competitive enhancement strategy (Crittenden 1999). Advantages of using the natural microbial ecosystem against the pathogens include ease of application and low economic and labor costs, and the use of a native population to reduce transient pathogens is seen as a natural strategy.

2:6:1 Types and sources of prebiotics:-

Non-digestible carbohydrates can be considered as prebiotics if they achieve the following criteria as noticed by Rastall and Gibson, (2006):

(A) Resistance to gastric acidity and mammalian enzymes.

(B) Susceptibility to fermentation by gut bacteria.

(C) Ability to enhance the viability and/or activity of beneficial microorganisms.

2:6:2 Industrial production of prebiotics:-

Numerous attempts have been made to separate and purify inulin an oligofructose for utilization as nutritional supports. At the present time, inulin and oligofructose are utilized in the pure form as ingredients in many food products, (Franck, 2002). Industrial production methods have been used to produce non-digestible carbohydrates (NDCs) from natural sources by hydrolyzing polysaccharides, enzymatic and chemical synthesis from disaccharide, direct extraction to produce soybean oligosaccharides and raff nose, and by some rization reaction to produce lactose (Mussatto and Mancilha, 2007).

2:6:3 Action mechanism of prebiotics:-

Prebiotics compounds also enter the digestive system with food. They move into the stomach and small intestine, but are not broken down and absorbed like most nutrients in food. Like fiber, the prebiotics moves into the small and large intestine. The good bacteria living in the intestines can use prebiotics compounds as a source of energy. Since the good bacteria eat these compounds, they are able to thrive in the intestines (Murphy, 2001).

The use of prebiotics in cattle has been limited due to the ability of ruminants to degrade most prebiotics. The gut microbial population may be altered by the oligosaccharide interfering with the attachment of the harmful bacteria to the gut wall. As a mean of cell recognition all cell types have a unique configuration of carbohydrate containing compounds on their surface. Once attached, the bacteria are able to multiply and produce their harmful effects. Species such as (*Salmonella* and *E. coli)* have man nose specific lections which bind to mannose residues on the gut mucosal surfaces. By introducing mannose contain in compounds into the diet the binding by pathogenic bacteria is disrupted and instead they bind to the oligosaccharide and are carried out of the gut with the passage of digest (Vandana, et al, 2013).

Prebiotics is a selective substrate for one or a limited number of probiotics. Probiotics are stimulated to grow and produce short chain fatty acids by prebiotics. Consequently, prebiotics will be able to alter the colonic micro biota of the host towards a healthier composition. In order to confirm selectivity of a prebiotics it is important to accurately monitor the changes in the fecal micro biota during prebiotics supplementation both in vitro and in vivo (Kolida & Gibson, 2011).

The use of prebiotics in cattle has been inadequate due to the ability of ruminants to degrade most prebiotics, however enhancements in rumen-protective technologies may allow these compounds to be used in feedlot and dairy cattle (Callaway et al, 2008), considering also that several classes of non digestible oligosaccharides are found in plant cell wall in nature including feeds normally used for livestock feeding. Lema et al, (2002) and Fleige et al. (2007) investigated the effect of lactose in pre-ruminant calves in combination with E. faecium to determine influence and effect on the growth performance and on the intestinal morphology.

Chapter Three

MATERIALS AND METHODS

3:1 Study Area:-

A feeding trail was conducted at research farm unit, Animal production collage, Sudan University of since and Technology, from March to May 2016.

3:2 Diet formulations and feeding:-

Sixteen Sudan desert sheep uncastereted male lambs were purchased from Elsheikh Abu Zaid local market west of Omdurman. These animals were of an average live body weight (22.50 Kg). They are treated against internal and external parasites and injected with broad spectrum antibiotic, then they ear-tagged. For iso-caloric and iso-nitrogenous rations were formulated. Basal diet containing 38% sorghum grain, groundnut cakes 22%, groundnut hulls 20%, wheat bran 17% , limestone 2% and salt 1% were granulated and mixed carefully graded levels of prebiotics were added .Diet A contains free prebiotics , diet B supplemented with(1 .0 g/ kg) prebiotics, diet C (1.5g / kg) and group D (2.0g/kg). Experimental animals were distributed randomly to these dietary groups of 4 animals. Each animals group was put into a separate pen of two square meters and fed individually its assigned diet ad-libitum in a feeding trial for 60 days, offered clean water throughout the entire experiment, and the feed was weighed and offered to the animals once a day at 8 am.

Diet was formulated to meet the requirements of grower sheep according to NRC 1994.

Table (1): Prebiotics free basal diet composition

Ingredients	100%	Metabolic Energy MJ /KG	Crude protein (CP)%	Calcium (Ca)%	Phosphorus (p)%
Sorghum	38	5.17	5.32	0.185	1.22
Groundnut Cakes	22	2.61	9.59	1.55	1.4
Wheat Bran	17	1.77	2.86	0.255	1.09
Groundnut hulls	20	1.45	1.13	1.2	0.12
Lime stone	2	-	-	-	-
Salt	1	-	-	-	-
Total	100	11	18.9	3.79	3.83

*For the animal groups A, B, C and D prebiotics of 0 g/kg (A), 1g/kg (B), 1.5g/kg (C), 2g/kg (D), were added to the diet and feed animals each group individually respectively. The prebiotics added composes of 18% β-glucans and 27% manna oligosaccharides.

3:3 Dry Matter feed intake (g):-

At 8:00 am the diets were offered to each group. Feed refusals collected weighed and recorded daily. The daily feed consumption was obtained by subtracting feed refusal from the feed offered.

3:4 Body weight gain (g):-

All lambs were individually weighed at the beginning of experimental period and then weekly throughout the experimental period. Weighing was performed after overnight fasting and the weekly body weight gain will be calculated and recorded.

3:5 Final body weight and feed conversion ratio:-

At the end of experiment the final live body weight (kg) of each animal were taken and recorded. Also Feed conversion ratio was calculated by dividing the daily feed consumption (g) over daily weight gain obtained (g).

3:6 Blood Samples:-

Samples for blood parameters lest were taken weekly. For four consecutive weeks the blood samples were collected from jugular vein-puncture into vacationers containing di-sodium ethylene diamine-tetra-acetic acid (EDTA) as an anti-coagulant. More 5 ml of blood were drawn into plain, clean dry test tubes for serum analysis. Serum was separated by centrifugation and then stored at -20º C for later analysis. The whole anti-coagulated blood was used immediately for the determination of White Blood Cells (WBCs), hemoglobin (Hb), glutamate-oxaloacetate transaminase (GOT) and glutamate pyruvate transaminase (GPT) level in serum.

3:7 Statistical analyses

The obtained data were summarized and analyzed mainly in the form of descriptive as frequencies and percentage and one way ANOVA followed by least significant difference test (LSD) were used using IBM SPSS statistics for Windows program, Version 20.0. Armonk, NY: IBM Corp.

Chapter Four

4-Results

Table2. Effect of added graded levels of prebiotics on some performance traits.

Group	A	B	C	D	Sig
Prebiotics level(g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	
Experimental period/day	60	60	60	60	
Number of animals	4	4	4	4	
Initial average weight (kg)	22.75±1.96	22.25±1.71	22.50±1.96	22.75±2.22	
Feed intake (gm/day)	1010.83±150.18	1114.91±40.81	1007.7±69.16	1092.5±86.83	NS
Weight gain(gm/day)	256.25±62.87	283.33±13.61	204.16±36.96	227.08±26.68	NS
Final body weight (kg)	38.12±1.17	39.25±2.22	34.75±2.29	36.375±2.07	NS
Feed Conversion Ratio	4.04±0.55	3.94±0.22	5.02±0.62	4.85±0.56	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at ($p > 0.05$).

Table3. Effect of added graded levels of prebiotics on immunity and serum composition

Group	A	B	C	D	Sig
Prebiotics level(g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	
Experimental period/day	60	60	60	60	
Number of animal	4	4	4	4	
Hemoglobin (g/dl)	12.02±4.22	10.78±2.74	11.17±4.56	11.55±5.12	NS
White Blood Cells/mm^3	10714.28±681.86	11885.17±780.20	11428±630.84	11410±634.54	NS
AST (mg/dl)	250.92±23.08	248.6±30.54	278.68±20.25	243.45±13.09	NS
ALT (mg/dl)	50.28±11.12	46.57±10.82	42.78±10.08	41±15.34	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at ($p > 0.05$).

Table4. Effect of added graded levels of prebiotics on feed intake (g/week)

Group	A	B	C	D	
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Week 1	6866.67±185.61	7187.50±121.13	6950.00±140.09	7825.00±156.11	NS
Week2	7950.00±207.59	8733.33±142.18	7425.00±153.47	8700.00±292.07	NS
Week 3	8116.67±174.22	7722.22±71.17	7712.50±117.86	8625.00±68.39	NS
Week 4	9166.67±179.22	8400.00±172.32	8825.00±189.39	9700.00±97.07	NS
Week 5	7850.00±205.12	8050.00±192.02	7812.50±245.18	7925.00±169.08	NS
Week 6	6533.33^{c}±40.96	8502.25^{a}±96.71	6687.50^{c}±55.75	7700.00^{b}±87.68	**
Week 7	7033.33^{b}±163.54	9050.00^{a}±99.15	7750.00^{ab}±160.89	7412.50^{b}±103.90	*
Week 8	7133.33^{b}±204.07	9250.00^{a}±104.16	7300.00^{b}±140.82	7662.50^{ab}±166.33	*

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at (p > 0.05).

* : significant at (p>0.05).

**: high significant at (p>0.01).

Table5.Effect of added graded levels of prebiotics on weekly weight (kg/week)

Group	A	B	C	D	
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Week1	25.375±1.70	25.25±0.96	24.25±1.71	25±2.45	NS
Week2	27.75±2.40	27.5±2.08	25.75±2.42	26.75±2.75	NS
Week3	29.125±2.48	29±2.58	26.75±2.48	28.50±2.38	NS
Week4	31.625±2.54	31.625±2.08	28.5±2.54	31.50±3.00	NS
Week5	32.875±2.05	33.75±1.71	30.13±2.39	32.63±2.10	NS
Week6	34.25±1.86	35.875±1.55	31.50±1.73	34±2.31	NS
Week7	36.125±1.95	37.75±2.06	33.50±1.73	35.25±2.06	NS
Week8	38.125±2.07	39.25±1.70	34.75±2.21	36.37±2.28	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at ($p > 0.05$).

Table6. Effect of added graded levels of prebiotics on weight gain (g/week)

Group	A	B	C	D	
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Week1	2625±71.42	3000±71.40	1750±71.70	2250±71.43	NS
Week2	2375±109.62	2250±109.63	1500±82.48	1750±136.78	NS
Week3	1375±84.97	1500±82.48	1000±101.02	1750±71.43	NS
Week4	2500±145.80	2500±184.43	1750±145.71	3000±116.64	NS
Week5	1250±123.72	2250±106.71	1625±106.80	1125±89.88	NS
Week6	1375±107.14	2125±89.88	1375±107.14	1375±107.14	NS
Week7	1875±35.71	1875±35.71	2000±35.71	1250±71.43	NS
Week8	2000±80.66	1500±80.65	1250±71.43	1125±89.88	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at ($p > 0.05$).

Table7.Effect of added graded levels of prebiotics on Feed Conversion Ratio (FCR)

Group	A	B	C	D	
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Week 1	2.28^{b}±0.43	2.10^{b}±0.18	3.11^{a}±0.01	3.29^{a}±0.23	**
Week2	2.92^{b}±0.80	2.63^{b}±0.36	3.99^{a}±0.32	3.66^{a}±0.16	**
Week 3	5.10±1.51	3.76±0.12	4.65±0.39	4.28±0.23	NS
Week 4	2.95±0.58	2.68±0.22	3.30±0.66	2.88±0.34	NS
Week 5	4.90^{a}±0.90	2.97^{b}±0.53	3.04^{b}±0.40	5.08^{a}±0.33	**
Week 6	3.18^{bc}±0.06	3.00^{c}±0.39	3.50^{b}±0.02	4.05^{a}±0.14	**
Week 7	2.71^{c}±0.78	3.21^{bc}±0.32	3.73±^{b}0.39	4.77^{a}±0.59	**
Week 8	2.92^{c}±0.53	4.22^{b}±0.68	3.73^{bc}±0.61	5.18^{a}±0.44	**

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at ($p > 0.05$).

* : significant at ($p>0.05$).

**: high significant at ($p>0.01$).

Table8. Effect of added graded levels of prebiotics on Hemoglobin Hb (g/dl)

Group	A	B	C	D	
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Samples 1	11.88^{a}±1.32	9.00^{b}±1.83	11.88^{a}±1.32	11.50^{a}±1.29	*
Samples 2	12.15^{a}±0.93	9.75^{b}±1.50	11.25^{ab}±1.71	12.50^{a}±1.29	*
Samples 3	12.38^{b}±0.48	10.63^{c}±0.63	11.13^{c}±0.75	13.50^{a}±0.91	**
Samples 4	12.75±1.26	11.25±1.04	11.88±0.85	12.75±0.65	NS
Samples 5	12.50±0.58	11.63±1.32	10.75±0.87	10.25±1.66	NS
Samples 6	11.50±0.58	11.75±0.65	10.88±1.11	10.25±0.65	NS
Samples 7	11.00±0.91	11.50±0.82	10.50±0.71	10.13±1.03	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at (p > 0.05).

* : significant at (p>0.05).

** : high significant at (p>0.01).

Table9. Effect of added graded levels of prebiotics on White Blood Cells (WBCs mg/dl)

Group	A	B	C	D	Sig
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Samples 1	11000±260.82	10800±243.98	9750±214.29	9500±184.43	NS
Samples 2	10900±321.43	11200±123.72	10600±135.21	10200±148.69	NS
Samples 3	10800±300.23	11700±85.71	11200±148.69	10900±135.21	NS
Samples 4	10800±222.08	12000±193.43	11500±82.48	11200±92.21	NS
Samples 5	10400^{b}±178.57	12500^{a}±174.96	12400^{a}±68.39	12600^{a}±147.25	*
Samples 6	10600±147.25	12500±273.55	12200±123.72	12600±68.39	NS
Samples 7	10600±213.29	12500±193.43	12200±92.21	12800±123.72	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at (p > 0.05).

* : significant at (p>0.05).

Table10. Effect of added graded levels of prebiotics on Asparatate aminotransferase (AST mg/dl)

Group	A	B	C	D	
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Samples 1	233.50±8.54	189.50±21.67	259.25±31.92	217.5±91.94	NS
Samples 2	232±51.83	258±15.77	292.50±71.34	252.75±38.52	NS
Samples 3	242.75±45.67	253.25±9.00	281±66.72	225.25±42.21	NS
Samples 4	260±41.56	263.50±21.86	289.75±76.28	195.75±94.62	NS
Samples 5	217.25±66.70	236±44.58	221±33.17	230.5±38.32	NS
Samples 6	251.50±39.05	260.25±41.15	267.50±25.93	262.25±43.58	NS
Samples 7	319.50±31.80	279.75±67.26	339.75±21.75	320.25±94.83	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at ($p > 0.05$).

Table11. Effect of added graded levels of prebiotics on Alanin Aminotransferase (ALT mg/dl)

Group	A	B	C	D	
Prebiotics level (g/kg)	0	1	1.5	2	
	Mean±St.D	Mean±St.D	Mean±St.D	Mean±St.D	Sig
Samples 1	44.75±14.52	34±18.24	41.50±22.84	47±12.30	NS
Samples 2	46.50±21.46	48.25±8.38	45±22.47	56.75±21.55	NS
Samples 3	48±23.89	47.50±8.06	45.50±19.00	45.25±14.82	NS
Samples 4	61±18.67	62.25±18.23	44.75±14.36	30.75±15.17	NS
Samples 5	56±13.93	55.50±21.30	40.25±5.91	32.75±12.89	NS
Samples 6	49.75±19.96	44.50±14.43	41±5.03	35.25±13.89	NS
Samples 7	46±27.70	34±15.77	41.50±10.08	39.25±21.34	NS

Key:

Mean±std: mean ± standard deviation.

NS: Not Significant at ($p > 0.05$).

Chapter Five

5-Discussion

The effect of added graded levels of prebiotics on some performance traits of sheep was shown in table (2). Although there is no significant (p>0.05) difference among the experimental groups in the overall studied parameters, group B (1 g/kg prebiotics) showed a higher record for the most studied parameters. Followed by group A (0 g/kg prebiotics), group D (2 g/kg prebiotics) and group C (1.5 g/kg prebiotics) which signed the lowest values for feed intake (g), weight gain (g) and final body weight (kg).Similar result was obtained by Milewski et al, (2010) who studied the effect of a feed supplement containing increased levels prebiotics on the meat performance traits and selected indicators of humoral immunity in suckling lambs. The beneficial effects of using Isomaltooligosaccharides for a number of animal species including broilers have been reported by many researchers (Zhang et al, 2003); (Thitaram et al, 2005); (Rehman et al, 2009), pigs (Li et al, 2009); (Li et al, 2010); (Li et al, 2009); (Zhang et al, 2011) and rats (Watanabe et al, 2002); (Sung et al, 2004). (Mizubuchi et al, 2005).

Adding prebiotics to diet of lambs by 1% as in group (B) has improved the final body weight, feed intake and FCR (39.25±2.22 Kg,1114.91±40.81g, and 3.94±0.22 g feed/g gain, respectively) compared to control group (A) which recorded (38.12±1.17kg, 1010.83±150.18 g and 4.04±0.55) for the same above parameters, respectively. Result obtained for daily weight gain parameter has shown that there are high significant differences (P≤0.01) between groups B and A at the first 30 days. This finding was provided by Milewski, et al (2009), who reported that the body weight of experimental lambs was significantly different (P≤0.05) in comparison with control lambs (group A), after both 30 and 60 day of feeding diet supplemented with prebiotics. Also FCR improved by group B (3.94±0.22) compared to group C which recorded poor FCR (5.02±0.62). These findings were similar to those reported by Chowalit, et al, (2015), who noticed FCR was reduced when COS (Nuclear chit oligosaccharide) level was high as compared to control level.

Table (3) showed the effect of added graded levels of prebiotics on immunity and serum composition. The result revealed no significant difference ($p>0.05$) between the experimental groups for above parameters. Oligosaccharides (Os) are one type of prebiotics, which have recently received attention as immunomodulation nutritional supplements for different animal production systems as well as for humans (Kaur and Gupta, 2002); (Patterson and Burkholder, 2003); (Genc et al, 2007); (Rijnierse et al. 2011). Furthermore, IMO are known for their potential to activate the immune system, thereby enhancing resistance to diseases and improving lipid metabolism (Wang et al, 2001); (Mizubuchi et al, 2005); (Liet al, 2009). The addition of different levels of prebiotics to sheep diet in the current study failed to induce any significant impact ($P >0.05$) on Hemoglobin concentration and some immunological parameters in contrast with the findings of Milewski, (2009) concerning lambs raised until 70 day of age. This author reported significant changes in hematological blood indicators between control and prebiotics supplemental group. The positive effect of prebiotics in lamb nutrition and the resulting health benefits may due to the prebiotics qualities of the product used in the other studies.

Statistical significant differences between the experimental groups and control group were not observed only with regard to serum concentration of hemoglobin throughout the entire period of the study, expect in week 1 and week 3 group D (higher level of prebiotics) had significant higher hemoglobin concentration than other groups.

No significant difference between experimental groups was observed for Aspartate aminotransferase (AST mg/dl) of the studied Sudanese desert sheep.

In contrast to that reported by Wang, et al, (2016), that on day 14, the level of the immunoglobulin IgA, IgM and IgG in the serum of pigs were linearly increased($p>0.05$) with increasing IMO supplementation.

Addition of prebiotics to the diet of lambs can improve the overall performance although statistically not significant.

Chapter SIX

6-Conclusion and recommendation

6:1 Conclusion

In recent years the Sudan desert sheep gained great interest as an export commodity as well as meat and milk produced locally. The nutrition of sheep is therefore considered as the most important factor influencing its productivity and overall performance. Hence, feed additives are included in the diet fed to animal's e.g. prebiotics. In the current research graded levels of prebiotics were introduced in the diet and the impact on performance traits was studied. Dry matter intake, daily weight gain, final weight gain and feed conversion ratio showed variable improvement among experimental animals groups fed on added levels of prebiotics in the diet, although the statistical analysis revealed no significant difference ($p>0.05$) between the mean values of studied performance parameters. Similar results were also obtained for mean values of hemoglobin concentration, white blood cells, asparatase aminotransferace and alanin aminotansfearce of the different sheep groups. So, the addition of prebiotics can improve the overall performance of the prebiotics can improve the overall performance of the lambs. Yet, this may be dependent on several factors, such as quantity and level of prebiotics used and other managerial and environmental condition.

6:2 Recommendations:-

- Encouragement of using prebiotics as part of the diet in sheep nutrition.
- The graded levels of added prebiotics to the diet showed be carefully formulated.
- More research works on effects of prebiotics on overall performance of sheep should be carried out.

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