



# Effects of supplementation with *Zornia glochidiata* Seeds on Feed Intake, Nutrients Digestibility and Sudan Desert Bucks Performance in Kordofan, Sudan

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## ABSTRACT

This study was conducted in North Kordofan State during March-June 2017, to study the effects of supplementation of Desert bucks on sorghum straw with *Zornia glochidiata* seeds on voluntary dry matter intake, nutrient digestibility and body weight change. Twelve Desert bucks at 7 to 9 months old with an average weight of  $12.500 \pm 0.250$  kg were divided into three similar groups. Each animal was housed in a separate barn with feeding and drinking troughs, and the animals were ear-tagged to facilitate identification during treatments. The bucks were treated against external and internal parasites using broad-spectrum anthelmintics. They were also weighed at the beginning of the experiment and once a week until the end of the experiment. The first ten days were considered an adaptation period and the experiment lasted for 60 days. Feed ingredient samples were analyzed using proximate analysis. *In vitro* and *In vivo* digestibility coefficients were determined in laboratory and using total feces collection method, respectively. The experiment was that of complete randomized design and the data was analyzed via analysis of variance. The results of the study showed that feed intake of the group supplemented with the concentrate ration and *Zornia glochidiata* seed was significantly ( $P \leq 0.01$ ) higher than the intake of the group on sorghum straw alone. The results of the chemical analysis indicated higher protein, ether extract and the nitrogen-free extract in *Zornia glochidiata* seeds and the fiber was low while high fiber content and low CP, EE and NFE in sorghum straw. *In Vitro* and *In Vivo* digestibility showed higher values in the group supplemented with the concentrate ration and *Zornia glochidiata* seeds than on sorghum straw alone. The mean weight gain was higher in the concentrate ration and *Zornia glochidiata* group than in the sorghum straw group. The study concluded that supplementing bucks on sorghum straw with *Zornia glochidiata* seeds could increase intake, digestibility and better weight similar to supplementation with the concentrate ration than the group that were fed straw. The study recommended conducting a comprehensive research to determine the nutritive value of the *Zornia glochidiata* seeds with other animal species.

## INTRODUCTION

Sudan is considered one of the richest Arab and African countries with its large animal population of cattle, sheep, goats and camels. Recent estimates have shown that the country owned about 103 million heads (30 million head of cows, 37 million heads of sheep, 33 million goats, 3 million heads of camels), in addition to 4 million heads of equine species, 45 million poultry and fish estimated at 100 thousand tons for internal fisheries and 10 thousand tons for marine fisheries, as well as large number of wild animals (EL Hag *et al.*, 2010).

The large population of goats in Sudan is raised under different production patterns mainly dependent on natural vegetation. They are raised mainly for dairy production, in addition to being a main source of meat in villages. They are suitable for breeding in areas with harsh natural and climatic conditions (Information Center, Ministry of Animal Resources and Fisheries, 2016). However, despite of these numbers, contribution of goats and to the production and marketing of red meat is limited due to its unpalatable smell, especially in adult animals, in contrast to their counterparts of lamb and cows (Birer *et al.*, 2014).

Goats are of great economic importance, especially in tropical areas where climatic changes are frequent and goats are characterized by early productive age (the first year of life), short gestation period not exceeding five months, and low production cost compared to other small ruminants. Their meat production in Africa alone is half a million tons, equivalent to 74.3% of the total meat production in the world (Rye *et al.*, 1992).

The main constraints for sustainable livestock animal production are poor genetic characteristics of the breeds, diseases marketing and most importantly feed shortage and high cost. Livestock species are largely dependent on natural grazing for their requirements of nutrients needed for different production functions (Jadalla 1995). The biomass from range lands is only of good quality during the short rainy season (3-4 months) and afterwards it becomes low quality roughage that cannot support maintenance requirements of the animals dependent on it let alone production requirements (Mohamed and Salih, 1991). Supplementation is needed during gestation, milk production, growth and other functions. Supplements are obtained at very high cost and sometimes ingredients used for ration formulation are either imported or competed for between humans and animals and not available in sufficient quantities (Jadalla *et al.*, 2012).

Some range plants and tree produce substantial amounts of seeds and pods that can be used as supplements for animals. No studies are carried out to examine suitability of such feed sources for supplementing livestock on low quality roughage.

### The objective of the study

The overall objective of research in this field is to contribute towards development of sustainable

livestock production systems based on available resources. In particular, this study aims to understand the effect of supplementation of goats on sorghum straw with *Zornia glochidiata* seeds on:

- total and daily feed intake of goats eating the dry substance
- The effect of supplementation with *Zornia glochidiata* seeds on the digestibility of nutrients when fed to Desert goats
- In vitro digestion of dry and organic matter using Desert goat rumen liquor
- Effects of supplementation with *Zornia glochidiata* seeds of live body weight change.
- Feeding cost as affected by supplementation with *Zornia glochidiata* seeds

## MATERIALS AND METHODS

### Study area

The state of North Kordofan is located between latitudes 12-40-17-20 north and longitudes 28.40-32.20. El-Obeid is the capital of the State with an area of 840-190 km<sup>2</sup>. The main occupation for the inhabitants of the city is provision of services and marketing of agricultural products in the city while rural inhabitants are mostly farmers and agro-pastoralists.

The state is generally characterized by its location in the African Sahelian region and can be divided into Desert climate that covers the northern parts of the state, characterized by high temperatures and low rainfall, with averages less than 50 mm per year. The desert region is relatively lacking vegetation, which resulted in the spread of the desert encroachment and sand. This region is followed by the climate of semi-desert. It covers the middle and southern part of the state and characterized by high temperatures and the amount of rain ranges between 50 to 150mm per year approximately. Some thorny shrubs are spread in this area in addition to seasonal weeds that provide natural pasture for animals, and the arable soil has of low fertility.

The livestock herding is considered one of the important economic activities, as 85% of the herders are nomads who depend in their social and economic life on animals that include sheep, cows, camels and goats. The total livestock in the state is 445,391 heads, according to the latest livestock census with goats being most important species raised. The total arable area is 24 million acres, of which 4,014,500 acres are independent. The state produces a number of crops, including corn, groundnuts, millet, sesame, hibiscus, melons, gum Arabic, sorghum and others.

### The experimental feed

Conventionally, rations used for feeding growing and fattening small ruminants are formulated using sorghum grains, sesame or cotton seed sunflower or groundnut seed cakes from oil pressing mills, sorghum or wheat bran, oyster, limestone or any source for minerals as well as the common salt. Chemical composition of the mentioned ingredients is presented

in table (1). The ingredients are increasing getting expensive and are competed for between humans and animals for food. Their production, especially grains is largely affected by amount of rainfall.

There is an urgent need for searching for new ingredients that are of good nutritive value, safe, available in sufficient quantities and can easily be

obtained. Some range plants and tree produce large amounts of seeds and pods that are not largely examined for using as alternative ingredients in livestock and poultry ration. *Zornia glochidiata* is one of those promising species and it produces large amounts or seeds every rainy season.

**Table( 1) chemical composition of the ingredients used in rations**

Ingredients	DM	OM	CP	CF	EE	NFE	ASH
Sorghum grains	92.52	88.77	14.47	2.3	2	2	3.8
Groundnut seed cake	90.52	79.55	33.30	6.5	4.5	1.44	10.97
Wheat bran	90.38	85.38	16.92	12.5	4	0.13	5.4
Limestone	95	-	-	-	-	-	95
Salt	97	-	-	-	-	-	97
Sorghum straw	90.84	77.89	8.40	35.13	1.23	19.38	12.95
<i>Zornia glochidiata</i> seeds	95	87	29	21	32	5	8

**Table( 2). The chemical composition of the rations used in feeding bucks**

Nutrients	I	II	III
DM	91.514	92.51	90.84
OM	89.66	81.88	77.89
CP	19.19	22.76	8.48
CF	16.30	10.38	25.13
EE	3.13	8.37	1.23
NFE	52.89	50.37	41.38
ASH	10.65	10.63	13.95

I concentrate ration    II *Zornia glochidiata* seeds    III sorghum straw

*Zornia glochidiata* seeds were collected from the natural pastures of the state. The sorghum straw was secured from farmers near the site. The chemical composition of the ingredients and the feed used for ration formulation were analyzed and the calculated nutritional values of the feedstuff used in the experiment are shown in Table (1).

### Experimental animals

The experiment was conducted in a special pens prepared for the purpose in El-Obeid city, starting in May 2017, where each of the experimental animal was housed in a separate pen. The experiment included 18 heads of male Desert goats aged 6-9 months and 12.5 kg. The animals divided into three groups with an average of 12.500 kg. The pens were provided with feeders and drinkers and water was provided continuously. The animals were ear tagged to facilitate identification during treatments. The goats were vaccinated against the endemic diseases in the study area, and the animal was given a broad-spectrum

anthelmintic. Mild disease cases were treated with antibiotics. The animals were weighed at the start of the experiment and once every week until the end of the research period. The consumption of feed (sorghum straw, *Zornia glochidiata* seeds and the ration) was estimated and drinking water was supplied in sufficient quantity.

### Monitoring Feed intake and body weight change

Feed was provided daily in the morning at seven o'clock, with a weight of half a kilogram of concentrated feed or *Zornia glochidiata* seeds. The straw was provided *ad libitum* for the three groups. Ten days were allowed as adaptation period before taking data on feed intake and weight change. The second group was supplemented with *Zornia* seeds while the third group was offered concentrate ration.

### Chemical analysis and *in vitro* digestibility Determination

**Table (3).In vitro dry matter and organic matter digestibility as affected by intake of *Zornia glochidiata* seeds**

Feed	Dry Matter	Organic matter	SE
<i>Zornia seeds</i>	68	72	
Sorghum straws	46	51	
Concentrate supplementation	65	70	

**Table (4). Apparent nutrient digestibility coefficients of Nutrients of sorghum straw alone and when supplemented with Zorina seeds**

Nutrients	Zornia seeds	Sorghum straw	Conc.	Standard Error
Dry matter	65	45	76	+3.4
Organic matter	67	49	71	+1.5
CP	70	55	72	+2.5
CF	55	34	48	+4.5
EE	77	60	80	+5.6
NFE	56	45	67	+4.5
ASH	-	-	-	-

Proximate analysis of *Zornia glochidiata* seeds, sorghum straw and ingredients used in ration formulation was conducted according to the methods described by AOAC (2000). In vitro dry matter and organic matter digestibility was carried out using methods described by Telly and Terrie (1963).

### Statistical analysis

The experimental data were analyzed using an analysis of variance to compare three treatments and the experiment was designed as a complete randomized design using the ANOVA test and least significance, LSD, method to detect differences according to Steele and Torrie (1996).

## RESULTS AND DISCUSSION

### The effect of intake of *Zornia glochidiata* seeds on feed intake of Goats

It was found that the dry matter intake was significantly ( $P<0.01$ ) higher for the group that was supplemented with the concentrate ration followed by the intake of those of sorghum straw and Zorina seeds and lastly those of fed on sorghum straw only. The goat groups consumed 750, 730 and 583 g/day for group supplemented with concentrate ration (I), with *Zornia glochidiata* seeds ( II) or sorghum straw alone (III), respectively. The increase in the dry matter intake in the group I and II could be justified by the higher protein content in *Zornia glochidiata* seeds and the ration unlike the sorghum straw that was very low in its CP content. This is in agreement with what was reported by McDonald *et al.*, (2010) that high protein leads to faster digestion in the ruminants and increases the consumption of feed. Concentrates sometimes lead to a decrease in the digestibility of fiber, but this is significant when these concentrates are high in starch such as food grains.

### Effects of *Zornia glochidiata* intake seeds on *in vitro* digestibility

The study indicated that *In vitro* digestibility of dry matter was significantly ( $P<0.05$ ) higher in the group that was supplemented with concentrate ration and *Zornia glochidiata* seed than those of sorghum straw only. The digestibility coefficients were 68, 65 and 46%, for the group on the straw and concentrate ration

followed by those supplemented with *Zornia glochidiata* seed and on sorghum straw alone, respectively. Also, the digestibility of organic matter was significantly ( $P<0.01$ ) higher in the group fed sorghum straw supplemented with a ration followed by the group supplemented with *Zornia glochidiata* seeds and the lowest feed intake was in a group on the sorghum straw alone. Feed organic matter digestibility was 72,70 and 50% for group I,II and III , respectively. Similarly this superior digestibility for the supplemented ration and seed might be attributed to high-protein for concentrated ration and *Zornia glochidiata* seeds that improved rumen ecosystem for microflora growth and feed digestion. These results are similar to those reported by Mohamed (2015) who observed that intake of protein rich tree pods led to a significant increase in the dry matter ingested, an increase in the digestibility of nutrients in the feed, as well as a significant increase in weight and daily gain in desert goat goats.

### *In vivo* Nutrients Digestibility as affected by intake of *Zornia glochidiata* seeds

The nutrients digestibility of the nutrients of the goat groups as affected by ingestion of *Zornia glochidiata* seeds have shown that the digestibility of the dry matter increased from 45% when only sorghum was fed to goats to 65 and 69% when the goats were supplemented with *Zornia glochidiata* and concentrate ration, respectively. Similarly organic matter digestibility increased from 49% to 67 and 71% upon supplementation. Digestibility of crude protein also increased from 55 % for sorghum straw to 65 and 70 % when goats were supplemented with *Zornia glochidiata* seeds and concentrate ration respectively. It was observed that crude fiber digestibility was low when the straw was the only feed for the goats and increased upon supplementation with *Zornia glochidiata* seed and the concentrate ration but it was observed that the *Zornia glochidiata* seeds enhanced CFD better than the concentrate ration. The crude fiber digestibility was 34, 48 and 55 % for ration for sorghum straw, supplemented with Zornia seeds and with concentrate ration, respectively. The decreased CFD is attributed to the high content of starch in the concentrated that suppressed bacterial activity leading low fiber digestibility and this in line with McDonald *et al.*,(2010) who reported similar observations. Nitrogen free extract digestibility was lower for the group on the sorghum straw alone and increased in groups supplemented with *Zornia glochidiata* seeds and the

concentrate ration but there were no significant differences were observed between the latter two feed types in digestibility improvement. The digestibility coefficient values were 56, 45 and 67 % for group I, II, III, respectively. Ether extract digestibility was the best when goats were fed the sorghum straw supplemented with *Zornia glochidiata* seeds followed by that of concentrate ration and was the lowest when the straw was fed alone. The digestibility coefficient values were 77, 60 and 80 % for group I, II, III, respectively.

#### The effect of intake of *Zornia glochidiata* seeds on the performance of Desert goat goats

The goat groups fed sorghum straw and supplemented either concentrate ration or *Zornia glochidiata* seeds had better weight gain at the end of the experimental period than the group that was left on sorghum straw alone. The reason for this increase in weight gained is due to the increase in the feed intake, improved nutrients digestibility and good supply of mineral elements needed for growth and fattening especially crude protein, ether extract, nitrogen-free extract, and the last two sources of energy necessary for growth and fattening. These results are similar to those reported by Mohamed (2015) who conducted an experiment by supplementing Desert bucks on natural grazing similar to the straw with *Dichrostachy scinerea* pods rich in crude protein, ether extract and starch and found that weight gains was similar to that of supplementation with concentrate ration. As reported also by Dahia (2015), an increase in the intake of feed, nutrients digestibility and weight gain could be attained by feeding desert bucks on sorghum straw with good quality roughage such as groundnut haums and *Ailanthus excels* rather than the expensive rations formulated using grains and oil seed cakes. Najla (2013) found that the pods and leaves of *Acacia mellifera* could lead to a significant increase in the weight of Desert goats.

#### General performance of the goat groups as affected by intake of *Zornia glochidiata* seeds

Table (4) summarizes the results of the experiment on performance of the three experimental goat groups as affected by supplementation with *Zornia glochidiata* seeds. Three experimental animal groups were fed sorghum straw *ad libitum* and one group was supplemented with *Zornia glochidiata* seeds and the second with a concentrate ration that is conventionally offered for bucks and the last group was left without supplementation. The initial weight was similar with an average of 12,250 + 0.250 kg and during 60 days their feed intake, live body weight and general performance was monitored. The total feed intake during the trial period was 35 kg for the group on sorghum straw only group versus 45 and ...kg for the group supplemented with *Zornia glochidiata* seeds and the concentrate ration respectively. Hence having the daily feed intake being 583 and 750 g and 730g for group I, II, and III, respectively. The final live body weight gain was 9.166, 25 and 30..833g/df for group I, II, and III, respectively.

#### The effect of intake of *Zornia glochidiata* seed digestibility

The digestibility of the nutrients as determined via total feces collection method was found being higher in the groups that were on the sorghum straw and supplemented with concentrate ration and the *Zornia glochidiata* seeds than consuming the straw alone. The reason for the improved digestibility coefficients observed in this study might be attributed to the optimal rumen ecosystem for the microflora to grow and digest feed offered especially roughage. The reason for this excellent quality of digestive results is due to the containment of the *Zornia* seeds of higher protein % of good availability of protein, minerals and soluble sugars according to the results of the approximate analysis.

**Table (6). General performance of Goats fed sorghum straw alone or supplemented with *Zornia* seeds**

Parameters	Sorghum alone	Supplemented with <i>Zornia</i>	Supplemented with ration	SE
No of Animals	6	6	6	
Days on trial	60	60	60	
Initial weight	11.25	11.35	11.25	
Final weight	11.800	12.850	13.100	
Total feed intake(kg/60d)	35	45	56	
Daily feed intake(g/d)	583	730	750	
Live weight change (g/d)	9.166	25	30..833	

#### CONCLUSIONS

The study concluded that supplementation of Desert bucks on sorghum straw, poor roughage that available in large quantities as crop residue after harvesting this cereal grain crop with *Zornia glochidiata* seeds could improve utilization and the DM intake, In vitro and in vitro digestibility of nutrients was nearly similar to the values obtained through supplementation with

concentrate ration conventionally prepared for fattening small ruminants. Supplementation with *Zornia glochidiata* seeds reduced significantly feeding cost hence making possible production of low price meat from Desert goats. It is recommended that more studies be conducted to use seeds for ration formulation in replacement of ingredients conventionally used for ration formulation that are expensive and sometimes competed for between

humans and animals. It is also recommended that the plant species be cultivated for fodder and seeds production. Anti-nutritional factors that might be present in *Zornia glochidiata* biomass and seed since this plant is known for making nutritional disorder at some growth stage.

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