



# Weight Gain, Carcass Characteristics and Quality of Rabbit Meat as affected by Ration Type and Addition of Helba (*Trigonella foenum-graecum*).

Musa Ahmed Musa Tibin<sup>1</sup>, Salah Abd Elgabar Salah Bukhari<sup>1</sup>, Suleiman Eshag Mohamed Abdalla<sup>2</sup>, Salah Basar Hammad Dahia<sup>2</sup> and Jumaa Barram Jadalla<sup>3\*</sup>

<sup>1</sup>Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Al Sallam Elfula, Sudan.

<sup>2</sup>Department of Animal Production Faculty of Agricultural Sciences, University of Dallanj, Sudan.

<sup>3\*</sup>Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan, Sudan.

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\*Corresponding Author

Jumaa B. Jadalla

E-mail: [jumaaaringola2000@gmail.com](mailto:jumaaaringola2000@gmail.com)

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## ABSTRACT

This study was conducted to evaluate the effects of ration type and the addition of the helba (*Trigonella foenum-graecum* TFG) on weight gain, carcass characteristics, meat quality, feed conversion ratio of rabbits and blood components. Twenty male rabbits at 4-5 weeks of age and weighing of 325-335g were fattened. The rabbits were divided into four similar groups each with five (5) rabbits. The first and second groups were fed a ration with 18% protein formulated using 52% sorghum grains, 26% wheat bran, 21% groundnut seed cake, 0.50% salt and 0.50% multivitamins. *Trigonella foenum-graecum* seed powder was added at 10g / kg feed to the first group while the second was left without TFG powder. The third group was fed a ration containing 18% crude protein and was formulated with 31.76% sorghum, 16.81% groundnut seed cake, 47.43% barseem hay, 3% molasses 0.50% multivitamin and 0.50% salt, with 10 g / kg feed of helba (TFG) and the same ration was provided for the fourth group without adding the helba. The rabbit groups were fed for eight weeks and weighed weekly. The data were analyzed via analysis of variance. Twelve rabbits were slaughtered to evaluate carcass characteristics (hot and cold carcass weight, and dressing percentage that was found being 48.8, 49.3, 45.3, 58.1% for group I, II, III and IV respectively. Sensory assessment of meat (color, aroma, tenderness, juiciness, flavor and general acceptance) was done. The results indicated significance ( $p \leq 0.05$ ) increase in total protein and significant decrease in cholesterol in the first and third groups, which could be attributed to the type of ration and addition of helba that had positive effect on the rabbits. The panel test showed significant differences ( $p \leq 0.01$ ) in flavor, tenderness, juiciness, meat from group I and III, that was fed with the addition of the helba than the group fed a ration free of helba. The study concluded that the type of the ration and the addition of helba powder (*Trigonella foenum-graecum*) had positive effect on some components of blood (increased total protein and decreased cholesterol) and improved quality of meat. The study recommended further research into the effects of adding higher levels of helba powder and the effect of other additives that can improve the rate of gain in body weight, improve meat quality and reduce the cost of production.

## INTRODUCTION

In many Arab countries especially in Egypt, rabbit is reared as poultry and its meat is consumed widely. In Sudan rabbit is usually conceived as wild game animal that is hunted and eaten widely among some rural communities while urban inhabitants do not prefer its meat. Rabbit meat is not a part of most people's everyday diet worldwide, yet consumption of rabbit meat in 2017 alone was estimated to be around 1.5 million tons (Li et al., 2018). In this study, home reared rather hunted rabbits were evaluated for their performance in response to ration type and addition of helba (*Trigonella foenum-graecum*) and explored some aspects of rabbit meat quality and its acceptability.

Internationally as in Sudan, rabbit meat is often categorized as game, meaning meat that is acquired through hunting for sport or food, more specifically it falls under the category of "game proper" and as "ground game". However rabbit hunting comprises only a small portion of the annual rabbit meat consumption. Today rabbits are commonly bred and kept as livestock. The agricultural practice of breeding and raising domestic rabbits, mainly for their meat, fur and wool is called cuniculture. These rabbits are classified as poultry (Li et al., 2018).

Rabbit meat is classified depending on size. Fryer or young rabbit is a term for rabbits weighing from 1.5 to 3.5 pounds (0.7-1.6 kg) and less than 3 months of age. Rabbits weighing over 4 pounds (1.8kg) and usually over 8 months of age are referred to as roaster or mature rabbit (Li et al., 2020).

Rabbit meat production is highly profitable due to its high prolificacy and short reproductive cycle, its ability to convert a large percentage of protein intake into muscle mass and its simple feeding needs. It is said that on the same feed and water, rabbits can produce 6 times more meat than cows (Li et al., 2020).

In North Kordofan rabbit meat is readily consumed without prejudice or taboos. Most of this meat comes from hunting. Recently, it was tried as poultry project by some producers and they found difficulties in formulating rations, preparing proper housing and diseases management. There is also a need for marketing and convincing more consumers to take its meat as the case of beef, mouton, broiler meat and fish.

Feeding of rabbit as the case of all animal species is the main production cost and the most important environmental factor responsible for reproductive and productive performance. The studies in this field are meager in Sudan

### The objective of the study

The overall objective of this study is to assist in provision of high quality low cost meat that can be available for the average consumers that are unable to

afford paying for the meat of other animal species usually marketed.

The direct objectives are:

Evaluate effects of addition of helba (*Trigonella foenum-graecum*) seed powder on body weight gain of the fattened rabbit, on carcass characteristics and studying the effects of adding *Trigonella foenum-graecum* powder on meat quality

## MATERIALS AND METHODS

### The study site

Khartoum State, where the experiment was conducted, is one of the eighteen states of Sudan. Although it is the smallest State by area (22,142 km), it is the most populous (5,274,321) in 2008 census (Geohive, 2008 and population census 2008). It contains the country's second largest city by population, Omdurman, and the city of Khartoum, the capital of the State as well as the national capital of Sudan. The capital city hosts offices of the state, governmental and non-governmental organizations, cultural institutions, and the main airport. The state lies between longitudes 31.5 to 34° E and latitudes 15 to 16° N. It is surrounded by River Nile State in the north-east, in the north-west by the Northern State, in the east and southeast by the states of Kassala, Qadariaf, Gezira and White Nile State, and in the west by North Kordofan. There is short supply of meat and its price is out of reach for the low income consumers.

### The experimental animals and treatments

Local breed of rabbits were purchased from markets in Khartoum North with ages ranging from 4 to 5 weeks and with average initial weight of 325 to 335g. The rabbits were randomly grouped into four similar groups each with five animals and they were assigned to four treatments (rations). The animals were housed in a 2X3 square meter barn. The floor was made of concrete and had an alleviation of half cm for drainage during washing. The rations were provided manually and on a daily basis at 7:00 am and water was provided throughout the experimental period. The amount of feed consumed was estimated by subtracting the amount left from that was offered the previous day. Feces were collected for seven days for digestibility test. The animals were weighed at the beginning of the trial and once weekly thereafter for eight weeks. Blood samples were taken at the last week. The rabbits were fasted overnight and three from each group were slaughtered for carcass evaluation.

### The experimental Feed

Two rations were used in this experiment and they were formulated with ingredients shown in Table (1).

**Table (1). Ingredients used in formulation of rations used in feeding the Experimental rabbits**

Ingredients %	Rations			
	I	II	III	IV
Sorghum grains	52	52	31.76	31.76
Wheat bran	26	26	0	0
Groundnut cake	21	21	16.81	16.81
Barseem hay	0	0	47.43	47.43
Molasses	0	0	3	3
Multi-vitamin	.50	.50	.50	.50
Salt	.50	.50	.50	.50
Helba	1	0	1	0

1: ration high in sorghum and helba, II= I without helba III= Barseem + sorghum with helba IV=Barseem + sorghum without helba

Four groups of rabbits were fed two rations: II and IV were fed rations without helba addition as indicated in table 2. Groups I and III were fed rations supplemented with *Trigonella foenum-graecum* (Helba) powder. Molasses was added to group III and

IV. The chemical composition of each ingredient was determined prior formulation of the rations as shown in table 2. Molasses was first added as a binding ingredient and its valued was calculated as part of the ration input.

**Table (2). Chemical composition of ingredients used in rations for the rabbits**

Feed	DM	OM	CP	CF	EE	NFE	ASH
Sorghum grains	92.57	88.77	14.47	2.3	2	70	3.8
Wheat bran	90.78	85.38	16.92	12.5	4	0.13	5.4
Groundnut cake	90.52	79.55	33.30	6.5	4.5	1.44	10.97
Barseem hay	92.70	84.7	13.35	27.18	2.61	41.56	8.8
Molasses	75.36	63.12	3.52	-	1.5	58.1	12.24
Multi-vitamin	-	-	-	-	-	-	-
Helba	92.9	89.14	27.397	15.40	4.2	45.903	3.76
Salt	-	-	-	--	-	-	-

DM: dry matter, OM: Organic matter, CP: crude protein, CF: crude fiber, EE: Ether extract

**Table (3).chemical composition of the rations used in feeding rabbit groups**

Constituents	RATIONS/RABBIT GROUPS			
	I	II	III	IV
Dry matter	94.59	93.67	91.66	90.74
Organic matter	85.94	85.5	87.2	86.13
Crude protein	18.08	18.81	18.8	18.51
Crude fiber	5.95	5.8	15.68	15.58
Ether extract	3.07	3.03	2.75	2.79
Nitrogen free extract	37.19	36.73	45.63	45.17
Ash	5.71	5.68	7.88	7.85

1: ration high in sorghum and helba, II= I without helba III= Barseem + sorghum with helba IV=Barseem + sorghum without helba

### Slaughtering and carcass characteristics determination

The feeding of rabbits was stopped six hours before the slaughter, while the rabbits were allowed to drinking water. All the animals were weighed and the final weight of the rabbits was taken prior slaughtering. Twelve (12) rabbits from the total number were slaughtered taking three rabbits from each group. The slaughter was done manually and the carcass was carefully cleaned. The carcass measurements were taken such as the weight of the carcass; weight the intestines and all gastrointestinal organs, the lungs,

kidney, heart and the external parts like the head skin and the legs.

### The chemical analysis

The feed ingredients and feces were analyzed via proximate analysis as described by AOAC,(2000). The blood samples were determined according to the methods used to measure the concentration of glucose in the blood and ascitic fluid as determined enzymatically by means of a glucose oxidase-peroxidase procedure (Richterich *et al.*, 1962). The blood samples were taken directly from heart in samples of 5 ml for each rabbit of all groups in plastic

containers free of anticoagulant and samples were left for 1-2 hours to form the serum. The blood was separated from the serum by centrifugation (3000 cycles/ min) for five minutes. The serum was isolated in sealed containers and kept to the following analysis was performed: Total protein albumin Glucose globulin Glucose and cholesterol total fat (Blauärmel and Krüger .1976). The dry matter digestibility was determined according to the methods described by McDonald *et al.*, (2010) in the total feces collection method.

### Panel test

The Panel test was conducted at the meat processing laboratory at the Kuku Animal Production Research Center where the meat was washed well and left in the air for one hour, then cut into small pieces and drawn in the foie gras. The oven was placed at 240° C for 20 minutes and then distributed to dishes. The connoisseurs are trained on the taste test and the form is designed to determine the flavor, juiciness, color, aroma, tenderness, and over all acceptability taste of the expectations according to Heinz and Hautzinger (2007).

### Statistical Analysis

The experimental design was a complete randomized design and the data on body weight change of the rabbit groups and blood components were statistically analyzed via analysis of variance. The panel test data were analyzed via chi- square. The differences among means were detected via Least Significance Difference test (LSD).

### Caracas Characteristics

As indicated earlier, the rabbits were fasted for six hours prior to slaughter though they were left to drink

water during that period. The animals were weighed and that was considered their final weight before slaughter and then 12 rabbits were slaughtered from the total number; 3 rabbits from each group. The rabbit slaughtering and skinning was done manually and the carcass was carefully taken and then the process of extraction of the viscera was carried out.

The carcass characteristics that were determined that included weight of the carcass, weights of the full and empty intestines and all gastrointestinal organs, the weight of the internal organs (the lungs, Heart, Kidney, Liver, and the gastrointestinal tract), and the external parts (skint head, and legs). Blood was also weighed. The results of the parameters studies relating to carcass characteristics are presented in table (4)

## RESULTS and DISCUSSION

The results of all parameters studies indicated no significant differences ( $P>0.05$ ) that could be attributed to type of ration but addition of Helba, *Trigonella foenum-graecum*, powder induced significant differences ( $P<0.05$ ) in several parameters (table 4). There were no significant effects in some carcass characteristics among all four groups after feeding for 8 weeks in the weight of hot and cold carcasses and the percentage of reflux. The results indicated that there was a significant effect on total protein and cholesterol level. Table (6) indicates a significant decrease in the level of cholesterol in the treatment (I) and (II), where in both treatments significantly reduced cholesterol was observed compared to other treatments without helba addition. This may be due to the fact that while the feed type had no significant effect on albumin, globulin, total fat, cholesterol was decreased because *Trigonella foenum-graecum* was reported being responsible for suppressing formation of cholesterol.

**Table (4). The effects of rations type on rabbit Caracas characteristics**

Parameter studies	Treatments			
	I	II	III	IV
No animals	5	5	5	5
Final weight at slaughter (kg)	1.438 <sup>a</sup>	1.320 <sup>b</sup>	1.498 <sup>a</sup>	1.072 <sup>c</sup>
Hot Carcass weight(kg)	1.160 <sup>a</sup>	1.035 <sup>c</sup>	1.155 <sup>b</sup>	1.010 <sup>d</sup>
Cold carcass weight(kg)	1.040	1.020	1.040	1.020
Dressing percentage %	48.8	47.3	45.3	46.1
Weight of edible parts%	38.5 <sup>a</sup>	36.91 <sup>c</sup>	37.71 <sup>b</sup>	35.90 <sup>c</sup>
Weight of non-edible parts%	20.16 <sup>b</sup>	21.37 <sup>b</sup>	20.17 <sup>b</sup>	23.38 <sup>a</sup>
Weight of external parts%	0.80	0.80	0.80	0.70
blood %	13.91 <sup>c</sup>	16.67 <sup>a</sup>	16.69 <sup>a</sup>	15.89 <sup>b</sup>

1: ration high in sorghum and helba, II= I without helba III= Barseem + sorghum with helba IV=Barseem + sorghum without helba

Values with different superscripts on the same row are significantly different ( $P<0.05$ )

**Table (5). Effect of type of ration on different parts of rabbits' carcass weight**

Weight (g)	TREATMENT			
	I	II	III	IV
Head	120.00	125.00	115.00	110.00
Kidney weight	10.000	10.000	10.000	8.333
Feet weight	45.000	48.333	51.667	40.000
Lungs weight	40.000	10.000	10.000	10.000
Heart weight	12.000	11.000	10.000	11.667
Cold carcass weight	+ 40.747 646.67	540.00+ 40.747	480.00+ 40.747	510.00+ 49.905
Skin weight	100.00	93.333	91.667	80.000
Liver weight	33.333	39.333	44.333	43.333
Empty stomach	146.67	126.67	140.00	173.33
Full stomach	250.00	190.00	231.67	246.67
Blood weight	66.667	71.667	68.333	55.000

1: ration high in sorghum and helba, II= I without helba III= Barseem + sorghum with helba IV=Barseem + sorghum without helba

**Table (6 ).Evaluation of the Panelists of rabbit meat from different rations**

Parameters	Treatments				SE
	I	II	III	IV	
Color	7.3500	7.6500	7.3500	6.3000	0.3571
Flavor	6.2500	7.5500	7.2500	6.5000	0.4018
Aroma	7.0500	6.7000	7.5000	7.8500	0.3896
Tenderness	6.7000	7.4000	8.0500	6.9500	0.3392
Juiciness	7.0500	6.9500	7.6000	6.3500	0.3900
Overall acceptability	6.7000	7.1000	7.7500	6.8500	0.3520

1: ration high in sorghum and helba, II= I without helba III= Barseem + sorghum with helba IV=Barseem + sorghum without helba. Significant differences ( $P < 0.05$ ) Flavor, juiciness and tenderness

## DISCUSSION

### The Feed Intake of Rabbits

The results of this study have showed that there were no significant differences ( $P > 0.05$ ) among the four groups of rabbits on four different rations with or without helba powder (*Trigonella foenum-graecum*). The results obtained in this study were different from those reported by Sohail *et al.*, (2012), who obtained a significant increase in weight gain and feed conversion ratio when they added 8 g helba/kg feed. They were also not similar to the results of the study of Dal Bosco (2012), which recorded a significant increase in weight when giving male and female rabbits extract helba seeds powder at 2500 mg/ kg body weight and the results also differed from Ahmed *et al.*, (2018) who indicated a significant difference in the rates of live weights. The results are in agreement with the results of another study who did not find any significant differences in body weights (Sohail *et al.*, 2012). The authors showed no significant effect for adding 8 g helba per kilogram feed. Nevertheless the weight of hot and cold carcasses increased and the percentage of dressing percentage. The authors explained those differences to the absence of difference in the productivity traits, despite the presence of increase in live weight and final weight where rabbits gave the first and third treatments higher when the second and fourth treatments were given a diet supplemented by a

1% powder lower weight gain and the feed consumption ratio was higher for the third and fourth treatments of the first and second treatments. The rations with molasses were expected to be preferred by their taste for rabbits. It also reported to improve digestion and contains a high percentage of digested protein up to 14%. The addition of molasses also lowered ration fiber, increased vitamins and mineral salts especially calcium and phosphorus needed by rabbits. In fact increased feed intake of rabbits is reported being traits of different breeds.

It was also observed that there was no significant difference among all groups for the characteristics of the carcass and the results of this study were consistent with that of Zeng *et al.*, (2010), who did not report significant increase in the proportions of the internal organs when rabbits were fed rations without additives.

The results showed that there were significant differences in the level of cholesterol and total protein in the serum only for the studied chemical properties. The concentration of cholesterol in the fourth treatment was significantly reduced upon addition to 1% helba powder. At the same time there were no significant differences in the level of blood glucose, albumin and total fat and a significant decrease in the concentration of cholesterol by addition of the powder in the ration may be attributed to the low cholesterol rate supplementation with helba powder in the diet to lower cholesterol in the blood to contain The seeds of the

helba on some compounds that reduce cholesterol by inhibiting the activity of the enzyme in the liver, which has a role in the formation of cholesterol through the reduction process may be due to high protein in the treatment of the third and fourth to the teaching of clover while not for the type of food and the addition of ring seed powder any effect. The results were consistent with (Sohail *et al.*, 2012) as well as with Zeng *et al.*, (2009). who indicated that there was no significant effect of feeding 3 g of the plant seed powder at 10g / kg feed in the ratios of albumin, protein and total fat. The results of this study are in agreement with those reported by Dal Bosco (2012).

### The effects of addition of helba powder on meat quality

The results showed a significant difference in color and alkalinity in the third treatment for meat grading characteristics, and no differences were observed in the flavor and tenderness of the meat and general acceptance.

The results showed that there was a significant difference in flavor and juiciness in the third group's meat compared to control group. No significant differences ( $P > 0.05$ ) were observed in meat color, tenderness and general acceptance of all groups. This is due to the fact that molasses have a special flavor and taste that has a role in improving those parameters. Clover has high protein content and is known to have a clear effect in raising the proportion of fat deposited between the muscles in the meat of rabbits. This marbling is known to have improved flavor. Results also indicated significant differences in meat tenderness among rabbits feed group where the third group's meat was better in this quality. The better tenderness of the meat of that group might be attributed to the fat marbling in the meat due to inclusion of molasses in the ration as well as presence of fibrous hay that might resulted in microbial fermentation and release of more volatile fatty acids.

### CONCLUSION

The results of the study indicated that the type of ration had no effect on feed intake, weight gain and the overall performance of rabbits.

It was observed that molasses and hay diets were consumed insignificantly in high amounts and that could be attributed to their higher nutritional value and were more palatable.

### RECOMMENDATIONS

More research in the field of rabbit nutrition, especially rations, ingredients used and different feed of rabbits be carried out to test most suitable rations for the establishment of most suitable and sustainable feeding patterns especially for the small scale production since large farms for raising rabbits are run using commercial technical production packages.

The concept of consumers be changed towards adoption of acceptance of the meat of rabbits its

quality and emphasis be stressed on showing the high nutritional importance of this type of meat, making it a basic source of protein

The cost of rabbit meat is low thus consumers' acceptance and ensuring sustainable feeding and production system will enable producers to benefit from raising rabbit.

Different levels of supplementation with helba and other additives can be tried to improve quality of meat produced.

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