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SEX EFFECTS ON CARCASS AND NON CARCASS TRAITS OF SUDANESE MATURE BELLADI RABBITS

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Consumption of rabbit meat in Sudan is not uncommon. It is usual to consume mature rabbit meat either purchased or hunted. A study was conducted to evaluate carcass and non carcass traits of local rabbits in Sudan, Belladi, and to assess sex effects on these traits. 47 adult rabbits (14 males and 33 females) were slaughtered and used in this study. Traits studied were carcass traits live weight (BWT), carcass weight (Carcass), shoulder and neck cut (shoulder), ribs (ribs cut), rump (rump cut), loin (loin cut), dressing out percent (Dress %) and non carcass traits (Lung, heart, liver, kidney, stomach, intestine, head, skin, feet, tail). Results revealed that sex significantly ($p \leqslant 0.05$) affected Dress.% and loin weight. Females obtained higher values than males; they obtained 53.93 % and 124.70g versus 50.03% and 102.57g. Mature and carcass weights were 1788.07, 1757.82 and 896.86, 949.79 g in the males and females respectively. Whereas shoulder, rump and rib weights were found to be 101.43 Vs110.30, 175.07 Vs 178.52 and 73.71 Vs 70.64 g in males and females. Phenotypic correlations between traits studied were all positive and significant except for the correlation of Dress % with BWT and shoulder, and for the correlation of shoulder with rump. It is concluded that sex had limited effects on adult rabbit meat. The present study revealed that mature rabbit can be used safely as it contains low fat content and high protein percentages.

Key words: Carcass, Dressing, percentage, Ribs, Rump

Rabbit meat consumption is increasing rapidly as it is low in its cholesterol content. It is advocated to people for good health because it does not form uric acid during metabolism (Iyeghe-Erakpotobor, 2007). In underdeveloped countries, daily animal protein intake is below the minimum level of 35 g as recommended FAO (2006). Efforts should be directed towards micro-livestock which are unusual animal protein sources to fill this gap (Adesope 2000). Rabbitsas meat animals, are characterized by high fecundity and being non- competitive with human for cereals so they can contribute to a large extent in alleviating global shortage in proteins of animal origin (El Rahman, 2012). They are also characterized by being excellent feed converters to meat as they can utilize up to 30% crude fibres compared to 10% that can be tolerated by most poultry species (Egbo *et al*., 2001). El-Amin (1978) described the manners of rabbit keeping in Sudan. To improve quality, dressing percentage and the proportion of valuable body parts of growing rabbits need to be increased. Slaughter value varies according to breed, nutrition, keeping conditions, body weight and some less important factors (Rudolph, 1988). According to the investigation made by Szendro (1989) dressing percentage is not affected by age if rabbits are slaughtered at the same body weight. Marcella *et al* (1995) studied the effect of strain, feeding, age and sex on rabbit carcass. They reported that sire strain affected growth performance and carcass traits, the sex effect was not significant and the feeding plan did not influence growth performance and carcass traits because of the ability of the rabbit to adjust its feed intake to the energetic value of the feed. Marcella *et al* (1995) also concluded that the increase in rabbit meat consumption requires the marketing of portioned and processed products that can be obtained from heavier carcasses. To reach this aim using large

breeds or delaying the slaughter age can be practiced, but these methods result in either immature meat or excessive fat meat, so it is necessary to combine these procedures to individualize the optimum slaughter age for the chosen strain. Rabbit breeders need to characterize all local rabbit existing genome for feedlot and carcass traits and to assess factors that affect their expressions (Fayeye and Ayorinde, 2010). The objectives of this study were to evaluate carcass and non-carcass trait in local rabbits of Sudan as they were slaughter at mature age to improve their carcass quality.

MATERIALS AND METHODS

Study location:

This experiment was conducted within the premises of the Extension and Rural Development Centre, Faculty of Animal Production, University of Gezira in Managil town, Gezira Province. The mean high and low temperature and relative humidity levels during the experimental period, which lasted for four years, were 40 and 17° C and 66 and34% respectively.

Housing and management

The animals were housed in an open sided house made of brick walls, wire mesh supported with metal poles and corrugated iron sheet roof. The house was divided internally into small breeding pens with dimensions of 105×79×60 cm. These pens were used to house mates (sire and dam) until kindling then each dam with its kits would be transferred to a separate cage (1×1m) provided with clay pots as nests where they stay until weaning at six weeks . The animals were provided with a formulated ration (Table 1) *ad libitum* in addition to green fodder (Barseem, *Medicago sativa*) which was given frequently. Fresh water was also available in plastic containers throughout the day. Food was given daily, early morning, in plastic containers after removing the remaining spoiled food. Feeding and drinking containers were cleaned daily with soap and water. Rabbit houses were cleaned every day and the other from food particles, faeces and any other waste.

Experimental Animals:

This study was conducted using 14 male 33 female rabbits at mature age. Rabbits were deprived from food 12 hours prior to slaughtering. Animals were slaughtered according to Muslims practice after taking the slaughter weight. The head was removed at the atlanto-occipital articulation and weight and the four legs and tails were also weighted. Skinning and evisceration were done and the internal organs (stomach, intestine, liver, lungs, heart and kidney) were weighted. The hot carcass was weighed and divided into right and left by sawing along the vertebral column. The left side of the carcass was divided into 4 wholesale cuts (fore leg and shoulder, hind leg and rump, lion and ribs and neck) according to Ashbrook (1955). The traits studied include carcass and non carcass traits (weight of different cuts, head, liver, heart, Gut, skin and feet, kidney, lung and dressing out percente)

Statistical analysis

Data set was analyzed by SPSS Version 17 to obtain means, standard errors, and coefficients of variation. Sex and age effects were assessed by GLM model.

RESULTS AND DISCUSSION

Table2. Show least square means and coefficients of variation of carcass traits for mature rabbits (over one year). Results revealed that sex significantly ($P \leqslant 0.05$) affected loin weight and dressing out percent, females scored high values (53.93±0.45 Vs 50.03±0.69%, and 124.70±3.34Vs 102.57±5.12g for traits and in females and males respectively).

This result is not in agreement with Baiomy and Hassanien (2011) who estimated high dressing % in the males versus the females (48.9 Vs 47.1 In NZW). Marcella et al (1995) Fayeye and Ayorinde,. (2010) and Yalcin et al (2006) reported that sex had no significant effects on all carcass traits.

The results for other traits (sex combined) were 1766.83±32.48, 934.02±20.02, 107.66±2.58, 177.49±3.46, and 71.55±2.34g for live weight, carcass weight, shoulder weight, rump weight and ribs weight respectively. Head weight percent in this study shows no sex effects and the overall mean was 17.45% this estimate is higher

than one reported by Ortiz Hernandez and Rubio Lozano (2001).

Table 1. Experimental ration formulation

Ingredients	% in the Diet	Total protein	Total energy
grains	10	0.89	366.3
Groundnut cake	11	5.21	412.39
Wheat bran	40	6.4	1052.4
Groundnut hulls	24	1.27	439.2
Alfalfa hay	15	2.28	282.15
total	100	16.05	2552.44

Table 2. least square means, minimum, maximum and coefficients of variation of carcass traits as weights and as percentage of carcass weight for mature rabbit:

Trait	Sex	Mean	Mini.	Max.	C.V.%
BWT	male	1788.07±60.04	1667.14	1909.00	14.58
	female	1757.82±39.11	1679.05	1836.59	11.85
	total	1766.83±32.48	1700.78	1845.11	12.60
Dress. %	male	50.03*±0.69	48.63	51.42	7.96
	female	53.93*±0.45	53.02	54.84	3.23
	total	52.771±0.46	51.15	52.81	5.95
carcass	male	896.86±36.48	823.38	970.34	18.71
	female	949.79±23.76	901.93	997.65	12.79
	total	934.02±20.02	879.48	967.17	14.69
shoulder	male	101.43±4.65	92.07	110.79	16.77
	female	110.30±3.03	104.21	116.40	15.90
	total	107.66±2.58	100.28	111.45	16.42
	total %	23.07±.32	22.66	1.79	9.42
loin	male	102.57*±5.12	92.26	112.89	16.73
	female	124.70*±3.34	117.98	131.42	15.97
	total	118.11±3.14	107.48	119.79	18.24
	total %	25.30±.40	24.84	2.56	10.95
rump	male	175.07±6.40	162.19	187.96	17.30
	female	178.52±4.17	170.12	186.91	11.66
	total	177.49±3.46	169.10	184.48	13.37
	total %	38.18±.39	37.49	2.18	6.92
ribs	male	73.71±4.33	65.00	82.43	30.17
	female	70.64±2.82	64.96	76.31	18.32
	total	71.55±2.34	66.98	77.37	22.46
	total %	15.29±.34	2.30	15.32	15.13

Bwt =live weight, Carcass = carcass weight, shoulder = shoulder and neck cut, ribs= ribs cut, rump= rump cut, loin=loin cut, Dress % = dressing out percent

*Means are significantly ($p \leq 0.05$) different

Table 3. phenotypic correlations among carcass traits of mature rabbits.

trait	Live wt	Carcass	Dress %	shoulder	ribs	rump	Loin
BWT	1.000	.918**	.165	.752**	.833**	.637**	.967**
Carcass wt		1.0	.539**	.746**	.904**	.777**	.824**
Dress %			1.0	.268	.469**	.554*	.408*
shoulder				1.0	.718**	.357	.469**
ribs					1.0	.603**	.728**
rump						1.0	.717**
loin							1.00

**Correlation is significant at the 0.01 level

*Correlation is significant at the 0.05level.

Loin and ribs % in this study were 25.30 and 15.29% they are lower than the estimates reported by Baiomy and Hassanien (2011) for the two traits 33.30 and 19.70 % respectively . Where as shoulder and rump % were 23.07 , 38.18% which are higher than estimates depicted by same author (14.76 and 31.60)

Table 4.Non carcass traits for mature rabbits as weights (sex effects) and as % of carcass weights.

trait	sex	No.	mean	Mini.	Maxi.	C.V.%
lung	male	14	13.86±0.92	12.01	15.71	34.05
	female	33	12.79±0.60	11.58	13.99	21.50
	total	47	13.11±0.50	8.00	23.00	26.16
	Total%	47	1.41±0.05	.43	1.20	22.08
heart	male	14	4.50±0.32	3.85	5.15	18.89
	female	33	4.36±0.21	3.94	4.79	30.28
	total	47	4.40±0.17	2.00	8.00	27.05
	Total%	47	0.48±0.02	.11	.45	28.22
liver	male	14	41.71±2.04	37.62	45.81	20.95
	female	33	41.79±1.33	39.12	44.46	17.01
	total	47	41.77±1.10	22.00	58.00	18.03
	Total%	47	4.52±0.12	1.64	3.27	18.30
kidney	male	14	34.21±4.28	25.59	42.84	80.12
	female	33	24.33±2.79	18.72	29.95	30.70
	total	47	27.28±2.41	10.00	113.00	60.45
	Total%	47	2.1±0.21	.64	4.82	48.34
stomach	male	14	103.43^{a} ±14.93	73.36	133.49	171.37
	female	33	67.12^{b} ±9.72	47.54	86.70	17.74
	total	47	77.94±8.42	40.00	453.00	74.08
	Total%	47	8.54±1.08	2.77	24.26	86.51
intestine	male	14	138.00^{a}±7.21	123.48	152.52	22.69
	female	33	173.88^{b}±4.69	164.42	183.33	14.37
	total	47	163.19±4.58	51.00	244.00	19.25
	Total%	47	17.64±0.47	2.62	12.08	18.12
head	male	14	178.57^{a}±4.21	170.10	187.05	9.58
	female	33	152.70^{b}±2.74	147.18	158.22	9.92
	total	47	160.40±2.86	130.00	199.00	12.24
	Total%	47	17.45±0.47	7.64	11.23	16.54
skin	male	14	267.57^{a}±10.06	247.32	287.83	16.44
	female	33	180.33^{b}±6.55	167.14	193.53	19.25
	total	47	206.32±8.00	83.00	359.00	26.60
	Total%	47	22.32±0.88	4.88	18.15	27.14
feet	male	14	34.36±1.96	30.41	38.31	13.82
	female	33	38.58±1.28	36.00	41.15	21.15
	total	47	37.32±1.10	26.00	75.00	20.15
	Total%	47	4.05±0.13	1.45	4.25	22.30
tail	male	14	4.21±0.40	3.41	5.02	39.67
	female	33	3.88±0.26	3.36	4.40	36.34
	total	47	3.98±0.22	1.00	8.00	37.19
	Total%	47	0.43±0.02	0.08	0.45	38.82

Means with different letters are significantly different ($P \leq 0.05$)

Table.3 shows the phenotypic correlations among carcass traits of mature rabbits; they were highly significant ($P \leq 0.01$) for the estimates of live weight with the other traits

(>0.40) except dressing out percentage (0.165). The correlation of carcass weight with cuts weights, dressing percentage were all highly significant (P≤0.01) more than 0.50.The correlation of dressing % with, ribs, rump and loin weights were highly significant (P≤0.01) but low for the correlation of the trait with shoulder weight (0.268). The correlations among cut weights were all significantly high except for the correlation of rump weight with shoulder weight (o.357).

Table 5. Phenotypic correlations among non carcass traits of mature rabbit (over 1 year)

Trait	BWT	carcass	heart	Lung	liver	kidney	stomach	intestine	Head	Skin	Feet	tail
BWT	1.000	.92**	.30*	.56**	.52**	.52**	.24	.39**	.58**	.59**	.31*	.31*
carcass		1.00	.23	.54**	.41**	.48**	.000	.43**	.34*	.35*	.26	.23
heart			1.00	.26	.17	.10	-.03	.14	.42**	.16	.37**	.41**
Lung				1.00	.28	.46**	-.11	.15	.35*	.45**	.06	.10
liver					1.00	.30*	12	.23	.41**	.30*	.26	.23
kidney						1.00	.01	-.05	.30*	.51**	-.15	.07
stomach							1.00	-.07	.24	.27	-.02	-.04
intestine								1.00	-.04	-.15	.34*	.34*
Head									1.00	.80**	.22	.46**
Skin										1.00	.06	.20
Feet											1.00	.34*
tail												1.00

**Correlation is significant at the 0.01 level
*Correlation is significant at the 0.05level

Table 6. Overall means and S.E. of Meat Biochemical traits

Traits	Mean	S.E.
Moisture%	72.91	0.24
Crude Protein %	20.64	0.26
Ether extract%	1.37	0.04
Ash%	0.93	0.01

S.E.= Standard error

Table 7. Least square means of Meat Biochemical traits (sex effects)

Trait	Sex	Mean	S.E.
Moisture%	Male	73.65	0.34
	Female	72.17	0.34
Crude Protein %	Male	19.79	0.37
	Female	21.50	0.37
Ether extract %	Male	1.12[b]	0.06
	Female	1.63[a]	0.06
Ash %	Male	1.03[a]	0.01
	Female	0.83[b]	0.01

S.E. = standard error
Means with different letters are significantly different (P≤0.05)

Table 4. shows the least square means, minimum, maximum and coefficients of variation of non carcass traits as affected by sex. Sex significantly (P≤0.05) affected stomach, intestine, head and skin weights. Females were heavier for intestine (173.88±4.69 Vs 138.00±7.21 g), while males were heavier for stomach (103.43 ±14.93 Vs 67.12 ±9.72 g), head (178.57±4.21 Vs 152.70±2.74 g) and skin (267.57±10.06 Vs180.33±6.55 g). The average weight for other non carcass traits, lung, heart, liver and kidney were 1.41±0.05, 4.40±0.17, and 41.77±1.10 and 27.28±2.41 g

respectively. These results are in agreement to the findings of Abdel –Azim et al (2007). Coefficients of variation for non carcass traits were generally high except for the head.

Kidney and liver weight % in the present study are 2.1 and 4.52% these were in agreement with Oteku and Igene (2006) who estimated a range of 1.5-2.2 and 4.5-3.7% for the traits respectively. However these estimates were higher than estimates reported by Yaclin et al (2006). On the other hand Marcella et al (1995) estimated higher percentage for kidney weight (> 6%).

Table 5. depicts the phenotypic correlations among non carcass traits of mature rabbits. The correlations among various traits in this study were highly significant ($P \leqslant 0.01$). These findings were in agreement with Nwagu et al (2009) and Yaclin et al (2006).

The overall means of moisture, crude protein, ether extract and ash% in this study were 72.91±0.24, 20.64±0.26, 1.37±.04 and0.93±0.01% respectively (table 6.). Estimates for Ash and fat content in this study were lower than estimates reported by Gondret et al (1998) and Ortiz Hernandez and Rubio Lozano (2001).Where as moisture and protein content were in accordance to the finding of Cobos et al (1995) and Ortiz Hernandez and Rubio Lozano (2001). Gondret et al (1998) reported that rabbits reached Spanish market weight at late age (18 weeks) contained high protein (26.9 Vs 23.4 %) and low moisture (69.3 Vs. 74.05) in their meat than rabbits slaughtered at earlier age (11weeks).

Table 7 revealed that sex significantly ($P \leqslant 0.05$) affected ether extract and ash content of mature rabbit meat. Males were superior to females as they contain low fat (1.12±0.06%) and more ash (1.03±0.01%). For the tow traits female's meat contained 1.63±0.06 and 0.83±0.01% fat and ash respectively. On the other hand, sex had no significant ($P \leqslant 0.05$) effects on rabbit meat moisture and protein content (73.65, 72.175 moisture and 19.79 –, 21.50% for the traits in the male and female respectively). Hogg et al (1992) also reported high fat content in female goat meat compared to meat from. On the other hand Johnson et al (1995) found no sex effects on meat moisture, fat and protein content.

CONCLUSION

The present study revealed that mature rabbit can be used safely as it contain low fat content and high protein percentages.

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