EFFECT OF LIMITING ACCESS TO DRINKING WATER ON CARCASS CHARACTERISTICS, MEAT QUALITY AND KIDNEYS OF RABBITS

Ben Rayana A.[1]*, Ben Hamouda M.[2], Kaddech A.[3], Amara A.[4], Bergaoui R.[1]

[1]Department Animal Science, Institut National Agronomique de Tunisie, 43 Av Charles Nicolle, 1082 Tunis Mahrajène, Tunisia
[2]Institution de la Recherche et de l'enseignement Supérieur Agricoles, 30 rue Alain Savary, 1002 Tunis, Tunisia
[3]Centre de l'Agroalimentaire, 12 rue de l'Usine, 2035 Charguia II, Tunis, Tunisia
[4]Ecole Nationale de Médicine Vétérinaire, Sidi Thabet, Tunisia
[*]Corresponding author: benrayana.aniss@iresa.agrinet.tn

ABSTRACT

Feed restriction is a common practice to reduce post weaning digestive disorders in rabbits and to get carcasses with less fat. Water restriction is commonly used to induce feed restriction in growing rabbits. Two water restriction times (2 and 4 hours per day, continuously) were used in our trial carried in good sanitary conditions.

Thirty six rabbits were divided at weaning (28 days) into three groups: R2 with restricted access to drinking water from 35 to 80 days of age of 2 hours per day (from 8 to 10 am), R4 access to drinking water 4 hours per day (from 8 to 12 am) and T (control) with unlimited access to drinking water.

Six animals from each group were slaughtered at 80 days of age. Carcass measurements and meat quality were studied. Histological study for kidneys was carried out.

Relative weight of gastrointestinal tract increased with the degree of water restriction: 16.5, 18.4 and 18.9 for groups T, R4 and R2 respectively ($P<0.05$). Perirenal fat was lower in restricted groups, but the differences were not statistically significant. Scapular fat decreased of 2/3 or 1/3 respectively with limiting access to drinking water of 2 or 4 hours per day.

Compared to control group, meat of restricted groups contained more water: 70.3, 70.0 and 69.3% respectively for R4, R2 and T ($P<0.01$). The same tendency was observed for protein content: 19.2, 19.3 and 17.7% for groups R2, R4 and T, respectively. Fat content decreased in meat of restricted animals: 8.4, 8.2 and 8.1%, respectively for T, R4 and R2 ($P<0.05$). Water restriction induced decrease of carcass and meat adiposity. There were no differences between pH post mortem and pHu among the three groups. Water restriction did not affect kidney histology.

Key words: Water restriction, Growing rabbits, Carcass, Meat, Kidneys.

INTRODUCTION

Perrier and Ouhayoun (1996) observed that the effects on carcass yield, muscle/bone ratio depends on the type of feed rationing. Gondret *et al.* (2000) noted that feed restriction tends to decrease lipid content. The present work was undertaken to study the effects of limiting access to drinking water during the fattening period (35–80 days) on carcass characteristics and kidneys. The objectives of our trial are to compare the interest of two durations of access to drinking water on carcass and meat quality and kidneys of rabbits in good sanitary conditions.

MATERIALS AND METHODS

This study was carried out between the 23rd of April and the 14th of June 2007 at INAT research center in Mornag, Tunisia.

Animals and experimental design

Thirty six rabbit kits, from the rabbitry of INAT (Californian grandparent stock) were randomly divided at weaning at 28 days of age into 3 groups: T, R2 and R4 of 12 individuals, homogenous in body weight, sex ratio and origin (mothers). The animals from each sex and each litter were allocated to different lots. Rabbits from the three groups were placed in cages of 4 rabbits and received *ad libitum* standard commercial pellet food (10.45 MJ DE/kg, 15.5% crude protein and 16% crude fibre). Group T had unrestricted access to drinking water during the whole fattening period (35 to 80 days of age). Group R2 had access to drinking water from 35 to 80 days of age for 2 hours (continuously from 8 am to 10 am). Group R4 had access to drinking water from 35 to 80 days of age for 4 hours (continuously from 8 am to 12 am). Only one access to drinking water through a pipette in a 5 l tank was available per cage of 4 rabbits.

Measurements

Slaughtering, carcass and meat quality
Six rabbits from each group were slaughtered at 80 days of age. They were individually weighed before slaughter. Carcasses were prepared as recommended by Blasco *et al.* (1993). Body composition, proportions of all organs and carcass yields were determined as recommended by Blasco *et al.* (1992, 1993). After 24 h at 4°C, commercial carcass was weighed. Scapular and perirenal fats were removed from the carcass and weighed. Then, each carcass was divided into three parts: hind part, intermediate part and fore part. After one hour at ambient temperature, one thigh (hind part) was weighed and the muscle was removed from the bone and muscle/bone ratio was determined. After slaughtering, gastrointestinal tract was weighed for each animal. Digestive organs were separated and weighed. Scores from 1 to 5 were attributed to carcass as described in AFNOR NF V47-001 (2004). The score relates the general adiposity of commercial carcass.

The pH was measured in the left *biceps femoris* 15 to 20 minutes after slaughter (pH PM) and 24 hours at 4°C (ultimate pH, pHu). The decrease of pH was calculated (pH PM – pHu). Analysis of chemical composition of meat (m. *longissimus dorsi*) was carried out. Water, protein and lipid content was determined as described in AFNOR (NF V 04-401 (1968), NF V 04-407 (1972) and ISO1443 (1973).

Histology of kidneys
Six rabbits from each group were used in the histological study of kidneys. Immediately after slaughtering, kidneys (left and right) without perirenal fat depots were moved and placed in 10% (v/v) formaldehyde solution, then transferred to the pathologic laboratory of veterinary school of Sidi Thabet for histological examination. Samples were fixed definitely in 10% (v/v) formaldehyde solution for 24 hours. Then, they were included and conditioned in paraffin blocs and finally debited with a microtome in thickness lamellas of 3 at 5 µm of width then placed on lames, before being stored at a temperature of 42°C for at least 12 hours. After dehydration, the coupes were stained with haematoxylin eosin which is a tinctorial stain. It stains the nucleus in blue and the cytoplasm and intercellular structures in red. It perms to study the general topography of tissues, the cytology and lesions. For each kidney (left and right), an appreciation of lesions was carried out at four levels: cortex, junction between cortex and medulla, medulla and bassinet. A score were attributed for each kidney. The defined scores are: 0: absence of lesions; +: very discreet cellular degeneration; ++: discreet cellular degeneration

Statistical analysis

Analysis of variance was performed with SAS GLM procedure (version 9.1.3). Means were compared with the paired Student t test.

RESULTS AND DISCUSSION

Carcass characteristics

Water restriction had no effect on carcass yields (Table 1).

Table 1: Carcass yields of rabbits (80 days) having different times of access to drinking water

	Group				MSE
	T	R4	R2	Prob.	
Rabbits (no.)	6	6	6		
Weight before slaughter (g)	2195	2180	2135	0.89	245
Dressing percentage (DP)	59.53	58.35	57.84	0.35	2.30
Commercial Carcass (CC)	57.52	56.89	56.09	0.63	6.14
Reference Carcass (RC)	48.20	47.63	50.90	0.83	6.00

Means with different letters on the same row differ significantly at the 5% level (Duncan test)

Results in Table 2 shows that there are no differences for weights of different parts of carcass. Gastrointestinal tract is more important for restricted groups. Lebas (2002) noted that feed restriction favourites systematically the increase of digestive content. No significant effects of restriction under the weight of gastrointestinal organs were illustrated. Perirenal fat is lower in restricted groups (R2 and R4) than group T but the difference is not significant (Table 2). Scapular fat decreases of 1/3 when animals have access to water for 4 hours (0.32% of reference carcass) and decreases of 2/3 if access to water is for 2 hours per day (0.16% of RC).

Table 2: Effect of water restriction (2 or 4 h/d) on gastrointestinal tract, organs proportions and fat

	Group				MSE
	T	R4	R2	Prob.	
Gastrointestinal tract (% of live weight)	16.5^{b}	18.4^{a}	18.9^{a}	0.03	1.97
In % of Reference Carcass (RC)					
Hind part	37.1	36.8	33.7	0.16	3.2
Intermediate part	25.9	26.5	25.4	0.70	2.35
Fore part	37.6	37.5	36.1	0.70	3.51
Perirenal fat	1.05	0.74	0.66	0.15	0.34
Scapular fat	0.48^{a}	0.32^{ab}	0.16^{b}	0.03	0.19
Muscle/bone ratio	5.7	5.0	5.74	0.13	0.67
Score of adiposity	3.8^{A}	2.8^{B}	2.5^{B}	<0.01	0.58

Means with different letters on the same row differ significantly at the 5% level (Duncan test)

Adiposity appreciation

General adiposity is better with restricted animals compared to group T (Table 2). The differences were statistically significant ($P<0.01$). Limiting access to water engender feed restriction which induced a decrease in general adiposity.

Meat quality

There were no differences between pH PM and pHu (Table 3). The decrease of pH was the same for all groups showing that muscles contain the same lipid storage.

Table 3: Post-mortem changes of pH of the meat (rabbits aged 80 days)

	Group				MSE
	T	R4	R2	Prob.	
pH PM	6.33	6.36	6.31	0.83	0.15
pH24	5.83	5.81	5.79	0.78	0.94
Decrease of pH	0.50	0.55	0.52	0.91	0.07

Water content of meat was higher in groups R4 and R2 as compared to group T (Table 4). The differences were significant ($P<0.01$). Meat of restricted groups (R2 and R4) contains more proteins and less fat than group T. As mentioned by Gondret *et al.* (2000), restriction tends to decrease lipid

content. The values for group T (water, protein and fat) were almost similar to values mentioned by Ouhayoun and Delmas (1989).

Table 4: Chemical composition (water, proteins and lipids) of meat (%)

	Group				MSE
	T	R4	R2	Prob.	
Water	69.3^{B}	70.3^{A}	70.0^{A}	< 0.01	0.38
Proteins	17.7^{B}	19.3^{A}	19.2^{A}	< 0.01	0.26
Lipids	8.4^{a}	8.2^{ab}	8.1^{b}	<0.05	0.19

Means with different letters on the same row differ significantly at the 5% level (Duncan test)

Histology of kidneys

Very low lesions (cellular degeneration) in tubular epithelium at the level of the loop of Henle were observed (Table 5) on experimental groups (R2 and R4). They seem more pronounced in animals of group R2 (Figure 1). Hydric restriction does not effect on kidney histology.

Table 5: scores (0, + or ++) attributed to kidneys in function of lesions (frequency)

	T (n=6)		R4 (n=6)		R2 (n=6)	
	R*	L**	R	L	R	L
Cortex	0 (6)	0 (6)	0 (6)	0 (6)	0 (6)	0 (6)
Jonction between cortex and medulla	0 (6)	0 (6)	0 (4)	0 (4)	0 (2)	0 (2)
(images of cellular souffrance at the level of the loop of Henle)			+ (2)	+ (2)	+ (3)	+ (3)
					++ (1)	++ (1)
Medulla	0 (6)	0 (6)	0 (6)	0 (6)	0 (6)	0 (6)
Bassinet	0 (6)	0 (6)	0 (6)	0 (6)	0 (6)	0 (6)
Total Score	0 (6)	0 (6)	0 (4)	0 (4)	0 (1)	0 (1)
			+ (2)	+ (2)	+ (4)	+ (4)
					++ (1)	++ (1)

*: right **: left Absence of lesions in T group
R2 and R4: low at very low cellular degeneration only in tubular epithelium of the loop of Henle (cellular souffrance)

T: normal tubular epithelium **R4:** very discreet tubular degeneration **R2:** discreet tubular degeneration

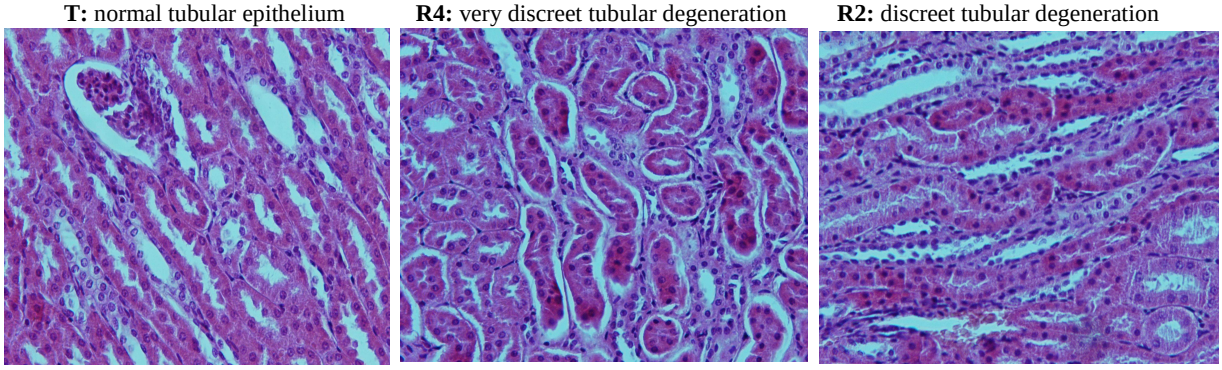

Figure 1: Photos of tubular epithelium (kidneys of rabbits aged 80 days)

CONCLUSIONS

Limiting access to drinking water for 2 or 4 hours per day decrease adiposity of carcasses and meat. Kidneys were not affected by water restriction.

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REFERENCES

AFNOR ISO 1443-1973. Association Française de normalisation. Informations provenant de la base «le référentiel», version septembre 1998. Viandes et produits à base de viande – Détermination de la teneur en matière grasse totale.

AFNOR NF V47-001 (2004). Echelle d'adiposité des carcasses de lapin.

AFNOR NF V 04-407 (1972). Viandes et produits à base de viande. Dosage de l'azote.

AFNOR NF V 04-401 (1968). Viandes et produits à base de viande. Détermination de l'humidité.

Blasco A., Ouhayoun J., Masoero G. 1993. Harmonisation of criteria and terminology in rabbit meat research. *World Rabbit Sci, 1, 3-10.*

Blasco A., Ouhayoun J., Masoero G. 1992. Status of rabbit meat and carcass: Criteria and terminology. *Options Méditerranéennes – Série Séminaires, n 17, 105-120.*

Gondret F., Lebas F., Bonneau M. 2000. Restricted feed intake during fattening reduces intramuscular lipid deposition without modifying muscle fiber characteristics in rabbits. *J. Nutr., 130, 228-233.*

Lebas F. 2002. Cuniculture: Biologie du lapin 4.4 Comportement Alimentaire. *http://www.cuniculture.info/Docs/ Biologie/biologie-04-4.htm.*

Ouhayoun J., Delmas D. 1989. La viande de lapin: composition de la fraction comestible de la carcasse et des morceaux de découpe. *Cuni-Sciences, 5, 1-6.*

Perrier G., Ouhayoun J. 1996. Effet de différentes modalités de rationnement à l'engraissement sur les qualités bouchères du lapin. *Cuniculture, 23, 147-154.*