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Effect of Incorporation of the Spineless *Opuntia ficus Indica* in Diets on Biochemical Parameters and its Impact on the Average Weight of Ewes During the Maintenance

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Abstract: The objective of this study was to evaluate the effect of the incorporation of the cladodes of *Opuntia ficus indica* in different maintenance diets for ewes on some biochemical parameters and its impact on the average daily weight. The experiment was conducted: in cross breed ewes on 16 ewes, divided into 4 groups: Diet 1 (control) barley straw + barley grain. Diet 2: (Straw + Opuntia), Diet 3: (Straw + Opuntia + field beans). Diet 4: (*Opuntia*), by comparing them. Total pectin's of *Opuntia* represent 34% of the residue parietal which15% of parietal low methylated pectins. The results (in g / l) of the triglycerides regimes, 2, 3 and 4, before and after incorporation of the cladodes, have varied from 0.59±0.03 to 0.08±0.01 and from 0.63±0.02 to 0.06±0.09 and 0.6±0.04 to 0.08±0.01 respectively. A slight increase in the level of uremia has been noticed in 3 regimes from 0.31± 0.03 to 0.33±0.02. The results in weight (g) of the diets 1, 2 and 3 showed a weight gain of 75±22, 26 ±7.2 and 93 ±19 g, respectively. A mean weight loss of about 83 ±13.2 g was given for the diet 4. The incorporation of the cladodes of Opuntia in food has satisfied the energy requirements of ewes, its use as a dietary supplement is recommended in dry areas. It showed the regulatory effect on blood glucose and hypolipidemic both in humans and animals.

Key words: *Opuntia* · Diet · Biochemical Parameters · Pectin's · Regulator · Average Weight

INTRODUCTION

The *Opuntia ficus Indica* is a xerophytic plant producing edible fruits and fodder for animals. The cladodes or snowshoes are high in water, fiber and nutrients but low in total nitrogen [1]. They are used as food aid during periods of drought, [2].The *Opuntia* plants CAM (Crassulacean Acid Metabolism), were a conversion efficiency of biomass per unit of water, superior to C3 and C4 plants and consequently digestible energy [3]. Recent discoveries have shown other nutritional benefits and health. They can be consumed as fresh vegetables or cooked [4], as they have been studied as a treatment of hyperglycemia, hyperlipidemia and atherosclerosis [5]. Their effects on the absorption of significant lesions and gastric ulcer have been studied by Lee and Lim [6] by consuming the cladodes powder. Tresoriere *et al,* studies [7] revealed that consumption of Opuntia has a protective effect on the immune system by acting as free radical scavengers.'s work. Tresoriere *et al*. [8] reported analgesic and anti-inflammatory actions of cladodes and fruit of Opuntia whose active ingredient is the â-sitosterol. A comparative study of fatty acids of different foods has shown that linoleic acid content of cladodes is less than that of alfalfa green [9] but higher than that of barley grain [10] one of the cons of Atti *et al*. [11] that the diets of Opuntia increased the proportion of polyunsaturated fatty acids. In addition, the xeric character of Opuntia allows it to fit under marginal conditions of soil and climate. In the context of aridity a nutrition survey was conducted to show the effect of the incorporation of the cladodes in different regimes, on some biochemical parameters and its impact on the gain and / or weight loss means. The cladodes of *Opuntia ficus indica* could be a significant source of bimolecular, as a source of fiber, minerals and natural antioxidants [12].

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The objective of this study is to evaluate the nutritional potential of cladodes, its effect on some blood parameters of sheep; it can cover the maintenance requirements? to maintain traditional forms of production in arid zones. In addition if the cladodes, it possesses therapeutic properties for both humans and the animals.

MATERIALS AND METHODS

Animals and Raw Materials: Sixteen ewes of Rumbi breed, in dry period, with an average age of 4 to 6 years and an average weight 40±2 kg. The animals were free from parasitic diseases, with a body condition of Score2 and placed in digestibility cages and divided into 4 groups. The previous regime was based on barley straw combined with additional barley grain. The cladodes of *Opuntia ficus indica* were from the region of Ksar-Chellala (wilaya of Tiaret) which is considered as a steppic region located 116 km from the capital of the wilaya. It is located in arid bioclimatic cool winter. The withdrawals of cladodes were made during the month of April 2009, at early flowering, at one year old, according by a random pattern. Other raw materials include: barley grains, field beans and barley straw, which are local products of the region.

Diets and Parameters Studied: The experiment was conducted on 16 ewes divided into 4 lots: Diet 1 (control) 0.65 kg DM barley straw + 0.3 kg DM barley grain. Diet 2: 0.661kg DM barley straw +0.425kg DM *Opuntia*, diet 3:0.661kg DM barley straw +0.195kg DM *Opuntia* + 0.125kg DM field beans, Diet 4: 0.825DM/kg *Opuntia*. Over 2 periods of 28 days each, with a change of regimes for the animals cross breed: (Diet 1 versus a diet 4) and (diet 2 versus diet 3). Calculation the distribution was made for the maintenance of the ewes dry ingested by the difference in the distribution and refused. The gain or loss on average daily weight of each diet was calculated as the difference between the final weight and initial /28 days. The blood samples were taken before the introduction of cladodes and end of experiment, comparing them with each other and compared to usual values of sheep. The UFL (fodder unit milk) and MAD (digestible nitrogen) of each raw material was determined by the prediction equations [13] for straw and concentrates; for Opuntia. The amount distributed was made to cover the maintenance requirements of sheep, it took into account the characteristics of the sheep with an average weight of 40±2 kg to maintain, its UFL = $0.033.p^{0.75}$, its digestible nitrogen = $2.52\ p^{0.75}$, the intake capacity of a sheep per 1.4 UEM: (unit congestion sheep) [14] and the size of barley straw in 2.33 UEM / kg DM [14] the rate of DM and the nutritional value of each food. The amount of fresh intake of Opuntia is about 2.5 to 9 kg fresh matter [15]. Feed intake for each diet was determined by weighing daily amounts distributed and refused. The power levels are considered the DM ingested, OM digested and nitrogen matter digestible angered. Power level = amount of energy (g OM digested / kg $p^{0.75}$) / 23 g. (23 g being the quantity of OM ingested in g per kg of $p^{0.75}$) necessary to cover the maintenance energy requirements of ewes. OMDi digested = OM ingested × apparent digestibility. Power level for N = Quantity of Nitrogen *dig*ested (g / kg $p^{0.75}$) / 2.52. (2.52 being the amount of Nitrogen ingested in g per kg of $p^{0.75}$) necessary to cover the needs of maintaining, the nitrogen sheep, Nitrogen ingested × apparent digestibility = digestible nitrogen. The evolution of body weight: the sheep were weighed on an empty stomach once a week, throughout the trial, to observe the weight change in g vif. ADG= Final weight - live weight initial/28. The ADG = first period + second period / 2. (OMi: organic matter ingested, OMdi: organic matter digested, MAD: crude protein digested, NA: power level, ADG: average daily gain).

Performance of the Test: Two meals / day were distributed: the food coarse straw, in the morning and at the same time for regimens 1, 2 and 3. The distribution of concentrates, took place 5 hours after taking the straw, with the exception of diet 4. Analysis of the constituents of each food was made according to conventional methods: the water content was determined by drying at 103° C±2°, the rate of crude fiber by Weende (AFNOR NFV 03 – 040), NDF and ADF the methodology described by Van soest *et al*. (1991). Total nitrogen by Kjeldhal and was converted to protein using factor 6.25 (AFNOR NFV 03- 05) the fat extracted with hexane according to the Soxhlet device (Quichfit England) for 9h. The parietal residue is obtained by the method of Harche *et al.* (1991), the extraction of cellulose and hemicelluloses from the parietal residue, according to the protocol of Chanda *et al*. (1950). The extraction of pectin was conducted using the protocol of Lamport (1977) and Thibault (1980) in (Monties, 1980). The highly methylated pectin's by hot water, for against the low methylated pectin's is extracted with EDTA (Ethylene diamine tetra-acetic acid). Blood samples were collected from jugular vein on an empty stomach, with Venoject in heparinized tubes, after centrifugation at 3600 rpm / 5mn and conserved in micro tubes at - 30 °C. Biochemical analysis was performed using a COBAS auto analyzer C111, at the level of the biomedical laboratory.

Statistical Analysis: The results of the various chemical analyses were treated by Excel software for the calculation of the mean and standard deviation and by the software Statistica version 6.0 for the analysis of variance and supplemented by the Newman-Keuls test for the classification of different regimes.

RESULTS

The chemical composition shows that the cladodes of Opuntia is rich in water, low to moderately high in CP, the content found 6% of CP / kg DM can be explained by the class of soil changed little, from alluvial OM content of 1.52%. For the composition of cell wall compounds shows that the cladodes of Opuntia is rich in pectin total of about 34% /DM, 15% low-methylated pectin. Well as straw is rich in NDF wall of about 65% / kg DM, it did not mean for pectin's. Overall cereal grains and legumes are low in pectin; they represent 2-5% of DM. The results of the nutritional value of each regime included in this study were 0.63±0.3 UFL/kg DM for Opuntia [16] indicates a value between 0.6 and 0.7 UFL / kg DM. The CP is in the order of 42.8±11.2g, 43g / DM against standards [17].UFL values and straw are MAD (nitrogen digestible) of 0.4±0.04 UFL / kg DM and 4.9±3.9g of MAD / kg DM, those of the barley grain are 1.09±0.04 UFL / kg DM and 70.4±15g of MAD / kg DM. The results of field beans are 1.07±0.02UFL / kg DM and 223.2±34g of MAD / kg DM.(Table 1). The UFL intake covers maintenance requirements of sheep regimes 1, 2 and 3. The regime 4 is in serious energy deficit. The Nitrogen ingested, only for regime 1 and 3 are able to cover maintenance needs. The results are recorded in Table (2).

Table 1: Chemical composition in % DM of the ingredients of the ration

	Ountia *Opuntia ficus in*	Straw	Barley grain	Field bean
DM	9.45±1.3	94.5±0.3	93.68±1.24	90.13±1..51
OM	86.88±1.26	93.05±0.8	96.07±0.27	97.2±2.79
CF	11.7±1.93	42.01±2.4	5.9±0.6	9.1±1.9
CP	6.03±1.2	3.4±0.61	9.8±1.18	25.3±1.17
NDF	29.42±2.5	65.4±4.9	18,5±0,18.5±0.9	14.7±1.21
ADF	17.1± 2.2	46.7±2.1	5,9±0.69	9.1±083
Parietal residue	52±4.2	-	-	-
Hemicelluloses	32±2.7	18.7±1.8	12.5±1.23	5.2 ±1.34
Pectins	34±1.87	-	-	-
UFL	0.63±0.3	0.4±0,04	1.09±0,04	1.07±0.02
MAD	42.8±11.2	4.9±3.9	70.4±15	223.2±34

Each value is the average of four observations±standard error. DM: dry matter, OM: organic matter, CF: crude fiber, CP: crude proteins. NDF: neutral detergent fiber. ADF: acid detergent fiber. UFL: feed unit milk (energy), MAD: digestible nitrogen.

Table 2: Quantity distributed and consumed in g /DM($BW^{0.75}$), chemical composition of diets, by lot, n = 8,period of 56 days

Ingrédient distibuted	SB	SO	SOF	O
Straw	650 -68%	661.5 60%	661.5-67%	-
Barley grain	300 32%	-	-	-
Field bean	-	-	125 - 13%	-
Opuntia	0 %	425.2- 40%	195- 20%	825- 100%
Total distributed	950	1086.7	981.5	825
Total Feed unit milk (ufl)	0.52	0.52	0.52	0.52
Ingrédient ingered	Diet1	Diet2	Diet3	Diet4
Straw	511	393	490	-
Barley grain	300	-	-	-
Field bean	-	-	125	-
Opuntia	-	425	189	460
$BW^{0.75}$	15.5±1.1	16.2±0.6	15.9±0.7	16.2±1.1
DM(g/$BW^{0.75}$)	52.32±3.27	50.49±2.5	50.56±3.2	28.39±2.85
OM	49.3±3.06	45.12±2.09	46.22±3.25	24.87±2.88
CF	15.5±1.14	13.08±1.01	14.74±1.68	3.24±0.21
CP	3.03±0.12	2.4±0.12	3.71±0.13	1.88±0.21
Pectins of *Opuntia*	-	8.81	4.04	9.65
Rate ingested OFi (%)	0	52	23	55
OMD digered	35.63±1.1	28.4±2.6	31.3±3.15	18.5±5.73
Level power energy	1.54±0.05[a]	1.23±0.11[b]	1.36±0.13[c]	0.8±0.08[d]
ADG(g)	75±22[a]	26±7.2[b]	93±19[c]	-83.6±13.2[d]
N digered	37.9±2.32	27.7±1.83	50.8±2.73	26.94±3.2
Level power nitrogen	1±0.02[a]	0.67±0.09[b]	1.26±0.03[c]	0.65±0.03[d]

SB: straw-barley; SO: straw-*Opuntia*; SOF: straw - *Opuntia*- field bean; O: *Opuntia* ab.bc, in the same line, when the letters are different there is a highly significant difference a $p < 0.01$. OMD i= OM ingered *CUDa(OM). N digered = N ingered*CUDa(N). CUDa : digestibility.= I-F/I*100. I : Ingered. F : feces

Table 3: Biochemical parameters in g/l before and after incorporation of Opuntia, by regime and lot, n=8, period of 56 days.

		SB	SO	SOF	O	T
Glycemia	Before	0.77±0.009[a]	0.59±0.03[b]	0.73±0.05[a]	0.67±0.04[c]	**
	After	0.52±0.04[a]	0.48±0.05[a]	0.398±0.09[a]	0.6±0.05[b]	*
Uremia	Before	0.24±0.03[a]	0.35±0.07[a]	0.31±0.03[a]	0.33±0.02[a]	NSD
	After	0.23±0.03[a]	0.14±0.03[b]	0.33±0.02[c]	0.04±0.009[b]	*
Cholesterol	Before	1.11±0.18[a]	1.02±0.13[a]	1.07±0.17[a]	1.07±0.17[a]	NSD
	After	0.55±0.03[a]	0.44±0.15[a]	0.25±0.07[b]	0.38±0.04[b]	*
triglycerides	Before	0.66±0.07[a]	0.59±0.02[a]	0.63±0.03[a]	0.6±0.05[a]	NSD
	After	0.4±0.05[a]	0.08±0.01[b]	0.06±0.01[b]	0.08±0.01[b]	**
Albumin	Before	32.38±2.24[a]	29.31±2.54[a]	29.07±5,1[a]	30±2.48[a]	NSD
	After	29.4±2.06[a]	30.5±.3.16[a]	28.2±5.34[a]	22.37±1.72[a]	NSD

SB: straw-barley; SO: straw-*Opuntia*; SOF: straw - *Opuntia*- field bean; O: *Opuntia*

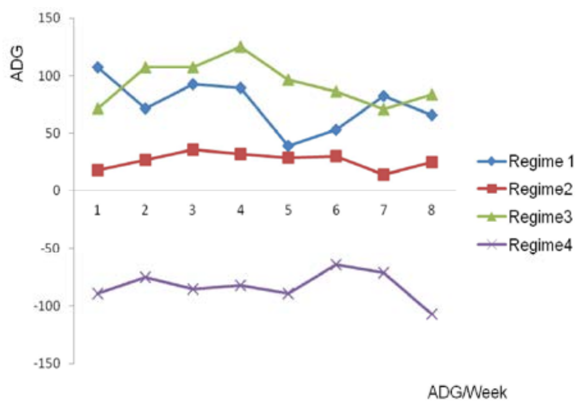

Fig. 1: Weight gain in g and / or loss through diet and per lot n= 8

The energy level of each regime was 1.54±0.05, 1.23±0.11, 1.36±0.13, 0.8±0.03, respectively. The regimes 1, 2 and 3 are capable of meet the energy needs. As for the nitrogen levels were 1±0.01, 0.67±0.09, 1.26±0.03, 0.65±0.03 respectively, only regimes 1 and 3 can to cover the maintenance requirements of nitrogen, however the regime 2 is most appropriate in conditions of extreme drought, it allows survival of animals. Analysis of variance showed that there is a highly significant difference at $p < 0.01$ between diet and biochemical parameters for Glycemia, uremia, cholesterolemia and triglycerides, before and after introduction and incorporation of Opuntia; by cons, the rate of albumin remained stable. The biochemical results are identified in (Table 3). The results of weight in regimes 1, 2 and 3 indicated a daily average weight of about 75±22.2, 26±7.2, 93±19; the regime 4 reported a loss of weight – 83 g±13.2 (Figure 1). The results of biochemical parameters are recorded in Table (3).

DISCUSSION

Glycemia is normally between 0.4 and 0.7g / l in the sheep and according to Haddad, [18] it is in the range of 0.4±0.07 for diets based on hay; 0.61±0.1 [19] and 0.55±0.05, according to Ndoutamia and ganda [20] in Arabic sheep. Blood glucose level in our study reached of 0.52±0.04, 0.48±0.06, 0398±0.09, 0.6±0.05 in groups 1, 2, 3 and 4, respectively and remains in the standards of the species, whatever the regime and each animal has its own mean Glycemia. However, the blood glucose before incorporation of *Opuntia* is increased (Table 3) but remains within standard value this can be explained by the contribution of concentrate ingested before the introduction of *Opuntia*; she has been lowered significantly after incorporation of Opuntia. This reduction in blood glucose in ruminants with low or no production can be maintained without any problems [21]. This is the example in diet 4 where the animal has ingested only Opuntia has been able to maintain blood glucose levels, or even greater than that of diet 1 (witness). This shows that the Opuntia is rich in soluble carbohydrates [22] and recently, [23] found that the concentration of starch is of 130.9 g / kg DM and 60.1g / soluble sugar / kg DM, with 90 % of fructose, so the blood sugar is a good indicator of the degree of satisfaction of the energy needs of animals. These facts show that the ruminant subjected to a regime of extreme scarcity is able to cover its energy needs-based on Opuntia. Although glycemia is not a valid criterion, because many experimental results are only conflicting interpretations of the authors; According to Fisher et al [24], they have observed variations in blood glucose in the same direction as energy balance, while others observed no change despite the significant drop in the levels of intake [25]. However, in studies carried out on Wistar rats and the results of Pimienta Barrios *et al*. [26] show that increased blood glucose 20 minutes after ingestion of Opuntia on healthy rats. The work of Mathews *et al*. [27] indicated that 3 hours after ingestion of Opuntia, blood sugar has balanced either in healthy than in diabetic rats. The fourth regime, while maintaining blood glucose standards recorded a weight loss of about 83±19.2 g (Fig. 6). Studies of Hernández-Ávila and Olaíz-Fernández [28] showed that the incorporation of cladodes has a negative effect on weight loss in rats, similarly, other investigators [29] found that a diet based exclusively on Opuntia showed a drop in weight of 620 g / week of Merinos sheep. It seems then that the Opuntia has a regulatory effect on blood sugar level followed by weight loss.

The usual values of uremia are in the range of 0.28±0.04g / l [19] and 0.43±0.08 [18] with a diet of hay and 0.32±0.17 for Ndoutamia et Ganda [20]. Results for uremia are consistent with the authors for diets 1 and 3 (0.23± 0.035 and 0.33±0.02 respectively), as contribution of barley grain concentrates and field beans, are medium to very rich in fermentable nitrogen, while for regimes 2 and 4, the rate of uremia is significantly lower (0.14±0.03 and 0.04±0.008) respectively; this mean that the listed diets confirm the low contribution of CP by *Opuntia* [22] (Table 3 and Fig. 2). Uremia increases with the protein rate and can be a valid criterion of the state of nitrogen nutrition of animals. Therefore, diets 2 and 4 must be completed by a nitrogen source like ammonia treated straw or urea, despite its deficiency in MAT, diet 2 (straw + Opuntia) is able to maintain its initial weight even a weight gain of about 26 g±7,2 g, with only 393 g of DM of straw and 425 g DM of *Opuntia* (Table3). While the witness group, fed with standard ration of sheep recorded a weight gain of 75±22g with 516 g DM of straw and 300 g DM of barley grain, it is certain that the ADG was greater for diets barley-based diets that Opuntia 46g VS 39g according to Abidi *et al*. [31], by cone in the conditions of drought, barley grain becomes a scarce or non-existent with much more problems of speculation, which even can undermine human food. Under such conditions, diet 2 he can replace the diet of the witness group: the 300 g of barley MS, can be replaced by 425g of *Opuntia* DM. The third regime shows a weight gain of 93±18g, since the incorporation of the field bean has compensate the deficit nitrogen recorded by the Opuntia. The results obtained by Tegegne *et al* [32] in Ethiopia, show a daily average weight gain of 41.5g with a diet consisting of untreated straw associated with *Opuntia* and wheat bran and 75 g of ADG with a diet based on straw treated with urea associated with Opuntia and wheat bran. The results of some authors [33] have shown a weight gain of 20g with a diet of Eragrostis straw, associated with 172g of Opuntia. The work of Nefzaoui and Bensalem [22] stated that it is possible to cover maintenance requirements for energy using systems based on spineless Opuntia, *ad libitum* with 300g of material dry straw. Our results are similar to the authors raised for diets 2 and 3. Standards in physiological cholesterol (g / l) are of 0.57±0.08 [19] and 0.65±0.51 [20] for Arabic sheep, it is of 0.73±0.35 for Peuhl sheep [20]. The results of cholesterol are consistent with the authors for diet 1 (witness group), 0.55±0.05g / l (Table 3), or diets based on Opuntia present a significant decrease at $p < 0.05$. Two interpretations seem plausible and possible: the first shows that the hypocholesterolemia is encountered during the cachectic state of the ewe [18] per cons diets 2 and 3 show a weight gain of 26±7.2 and 93±17. The second interpretation emphasizes the role of cholesterol in the racket of *Opuntia* as shown in work of Frati [34] who administered dried capsules of *Opuntia ficus indica* in healthy individuals and the rate of cholesterol was lowered in a meaningful way. The results of other authors [35] have reported that ingestion of fresh cladodes in healthy individuals generate lower cholesterol. It seems that the pectin of *Opuntia* interferes with cholesterol biosynthesis and with its blood regulation [36]. Our results representing 32%±2.1 of hemicelluloses parietal residue, with the results of high and low methylated pectin's are 19%±1.7 and 15%±1.3 respectively, representing 34 % 1.87 indicate that this Opuntia is considered a fibrous tissue in food and pharmaceutical interest. Other studies on dietary fiber have shown a decrease in lipid levels in healthy individuals. The study carried out in rats [37] showed that the pectin of Opuntia tends to reduce cholesterol by binding to bile acids and the increases of their concentrations enhance the catabolism of cholesterol. This cholesterol lowering effect was observed in healthy subjects and also in hyperlipidemics [38] and the rate of HDL and LDL varied significantly in Wistar rats, rabbits and humans [39] and even in hyperlipidemic Guinea pigs. As for the usual values ??of triglycerides, they were of 0.59±0.19 in the Arabic sheep and of 0.33±0.12 in Kirdimi species of Tchad [20]. The results of triglycerides are significantly lower except for diet 1 (witness group), 0.4±0.02, which has maintained its standards rate of triglycerides, by con, diets 3 and 4 based on Opuntia showed a highly significant difference at $p < 0.01$ between the witness group diet and diets based on *Opuntia*. The work of Chilliard et al [40], claim a sharp decrease in response to an underfeeding; per cons, diets 2 and 3 records a weight gain, as for the cholesterolemia, the Opuntia racket reveals the hypotriglycedemiant role of *Opuntia*. Works of Shuash- *et al*. [41] have argued that the incorporation of the *Opuntia* cladodes has changed in a very highly significant ($p < 0.001$) the triglyceride levels in healthy Wistar rats; however, the high concentration of triglycerides in diabetic rats did not decrease very significantly with the seed oil of the fruit of *Opuntia,* against a decrease in triglycerids levels was observed [34] in individuals with type 2 diabetes and that the regulatory effect of the *Opuntia* cladodes was identified in many species including *Opuntia ficus indica*, *Opuntia Fuluginosa griffith* and *Opuntia lindheimeri eglem* [43] This regulatory mechanism is still poorly understood and it likely that the pectin of the cladodes interferes in the absorption of lipids [44], but it seems that it is the interaction of many substances such as flavonoids, betalaines and vitamin E [45] which gives it the hypolipidemic activity. The interval from 4.04 to 9.65g ($BW^{0.75}$) of total ingested pectin, cholesterol level diminished ($P < 0.05$) and the rate of triglyceride diminished ($P < 0.01$) (Tables 2 and 3). In bibliographic studies, the standards of albumin are in the order of 41à 60 g / l, according to Smith *et al* [19] and of 39±7.2, according to Healy *et al.* (1979) and of 31.5±1.5 according to Ndoutamia and Ganda [20] in Arabic Sheep. Our results are similar to those of Ndoutamia and Ganda [20]; so, no statistically significant difference at $p < 0.05$ between the different diets, so, the rate of albumin reflects the storage capacity of the total protein when the diet is low in protein, case for diets 2 and 4, the urea is recycled to the rumen and little nitrogen is lost. Therefore, the amino acids that are not used in anabolism are catabolized in the liver and are degraded into CO_2 and urea and can provide energy through gluconeogenesis and consequently in weight gain.

CONCLUSION

In this study, it appears that glucose is in the standards of the sheep, whatever is the diet and shows the degree of energy needs of animals. The low rate of uremia for diet 2 and 4 but is offset by a stable rate of albuminuria. Invariably in humans like in animals, the incorporation of the cladodes seems to show a regulatory effect of glycemia and a hypolipidemic effect. In diet 2, with an ingested of 393 g of barley straw MS and 425 g of MS Opuntia, the ewe is able to cover its energy needs maintenance. Diet 3 can substitute for an extreme scarcity diet, with the condition to replace the feed bean by a cheaper nitrogen source like a straw treated with ammoniac. Diet 4 can not pretend a food foraging, with a weight loss of about 83 g. Today, the practice of consumers tend to eat fewer calories and less fat, especially since red meat of sheep is considered as the richest in cholesterol and this can be solved by the incorporation of the Opuntia cladodes in diets, whether for humans or animals. Further studies are needed to better understand the therapeutic properties of *Opuntia ficus indica*.

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REFERENCES

1. Nefzaoui, A., 2009. Improved utilization of cactus pear for food, feed, soil and water conservation and other products in Africa (proceedings of international work shop held in Mekelle. Ethiopia 19-21 international congress October 2009.
2. Le Houérou, H.N., 1996. The role of cacti (Opuntia spp.) in erosion control, land reclamation, rehabilitation and agricultural development in the Mediterranean Basin. J. Arid. Environnement, 33: 135-159.
3. Nobel S.P., Barbera G.P. Inglese and E. Pimenta-Barrios., 1995. Environnement biology. Edition.Agroecoloy, cultivation and uses of cactus pear.FAO. Rome (Italy), pp: 36-48.
4. Saenz C., 2000. Processing technologies: an alternative for cactus pear (Opuntia spp.) fruits and cladodes. J. Arid Environment, 46: 209-225.
5. Frati, A.C., E. Jimenez and C.R. Ariza, 1990. Hypoglycemic effect of Opuntia ficus indica in non insulin-dependent diabetes Mellitus patients. Phytotherapy Research, 4: 195-197.

6. Lee, J.C. and K.T. Lim, 2000. Effects of cactus and ginger extracts as dietary antioxidants on reactive oxidant and plasma lipid level. Food Sciences. Biotechnology, 9: 83-88.
7. Tresoriere, L., D. Butera, M. Pintaudi, M. Allegra and M.A. Livera, 2004. Supplementation with cactus pear (Opuntia ficus-indica) fruit decreases oxidative stress in healthy humans: a comparative study with Vit. C. Am. J. Clinique. Nutrition, 80: 391-395.
8. Tresoriere, E.H., H. Kahng and S.H. Lee, 2001 An anti-inflammatory principle from cactus. Phytothérapie Research, 72: 288-290.
9. Valvo, M.A., M. Lanza, M. Bella and V. Fasone, 2005. Scerra y acids of lambs fed exclusively maternal milk, Animal. Sciences, 81: 431-436.
10. Loor, J.J., W.H. Hoover, T.K. Miller-Webster, J.H. Herbein and C.E. Polan, 2003. Biohydrogenation of unsaturated fatty acids in continuous culture fermenters during digestion of orchardgrass or red clover with three levels of ground corn supplementation. J. Animal. Sciences, 81: 1611-1627.
11. Atti, N., M. Mahouachi and H. Rouissi, 2006. The effect of spineless cactus (Opuntia ficus-indica f. inermis) supplementation on growth, carcass, meat quality and fatty acid composition of male goat kids. Meat Sciences, 73: 229-235.
12. Ennouri, M., H. Fetoui, E. Bourret, N. Zeghal, F. Guermazi and H. Attia, 2006. Bioresourrces. Technologies, 97: 1382.
13. INRA, 1978. Prévision de la valeur nutritive des aliments des ruminants. Ouvrage collectif coordonné par C.Demarquilly. Edition INRA publications. Route de St -cyr, 78000 versailles. pp: 237-258,279-296.
14. INRA, 1988. Alimentation des bovins, ovins et caprins. Ouvrage collectif dirigé par Jarrige R. Edition INRA publications-France. 476 pages. pp: 420-431.
15. Monjauze, A. and H.N. Lehouerou, 1965. Le rôle des Opuntia dans l'économie agricole africaine. Bulletin de l'école supérieure agricole de Tunis, (8/9) :85-164.Cité par Mulas M; Mulas G. 2004.
16. FAO, 1989. Potentialités d'utilisation stratégiques des plantes *Atriplex* et *Opuntia* contre la désertification. /AGP/AGPC/doc/publicat/cactus Snt/cactus 2.htm.
17. CIHEAM (centre international des hautes études agronomiques méditerranéennes)., 1990.Tableaux des sous produits d'origine méditerranéenne. X.Alibes et J.L.Tisserand (eds),152pp. CIHEAM. Zaragoza.
18. Haddad, O., 1981. Contribution à l'étude des profils biochimiques chez les ovins :influence de l'alimentation. Mémoire de maitre Es sciences Vétérinaires. Ecole nationale de Toulouse. France.
19. Smith, M.L., R. Lee, S.J. Sheppard and B.L. Fariss, 1978. Ovine serum chemistry values. Am. J. Vet. Res., 39: 321-322.
20. Ndoutamia, G. and K. Ganda, 2005. Détermination des paramètres hématologiques et biochimiques des petits ruminants du Tchad Revue Médecine. Véterinaire, 156: 202-206.
21. Steel, J.W. and R.A. Leng, 1973. Effects of plane of nutrition and pregnancy on gluconeogenesis in sheep British. J. Nutrition, 30: 451-475.
22. Nefzaoui, A. and H.et Ben Salem, 1998. Spineless cacti: a strategic fodder for West Asia and North Africa arid zones..58-76, in: Proc. Int. Symp. Cactus Pear and Nopalitos Processing and Use. Facultad de Ciencias Agrarias y Forestales/FAO, Santiago, Chile.
23. Ayadi, M.A., W. Abdelmaksoud, M. Ennouri and H. Attia, 2009. Cladodes from Opuntia ficus indica as a source of dietary fiber: effect of dough characteristics and cake making. Ind. Crops Prod., doi:10.1016/j.indcrop. 01.003.
24. Fisher, L.J., P.E. Donnely, J.B. Hutton and D.M. Duganzich, 1975. J. Agriculture sciences. Cambridge, 84: 29-37.
25. Brett, D.J. and T.H. Stobbs, 1974. Milk yield and composition of milk and blood as indicators of energy intake by Jersey cows. Australie. J. Agriculture, 25: 657-666.
26. Pimenta-Barrios, E., L. Méndez-Moran and B. Ramírez, 1994. Effect of the ingestion of xoconostle fruit (Opuntia joconostle Web.) on glycemia and serum lipids. In: Felker P, Moss JR (Eds.) Proc Fifth An TexasPrickly Pear Council. Texas, USA, pp: 51-60.
27. Mathews K.C., K.E. Van Holde and K.G. Ahern, 2002. Bioquímica. 3ª Ed.Addison Wesley. Madrid, pp: 1335.
28. Hernández-Ávila, M. and G. Olaíz-Fernández, 2002. Diabetes and Mexico: a public health challenge. Ciencia, 53: 8-17.
29. Terblanche, I.L., A.M. Mulder and J.W. Rossow, 1971. The influence of moisture content on the dry matterintake and digestibility of spineless cactus. Agro-Animalia, 3: 73-77.
30. Chiou, P.W.S. and R.M. Jordan, 1973. Ewe milk replacer diets for younglambs. Effect of age of lambs dietary fat on digestibility of the diet, nitrogen retention and plasma constituents. J. Animal Sciences, 36 :597-603.

31. Abidi, S., H. Ben Salema, V. Vastab and A. Priolob, 2009. Supplementation with barley or spineless cactus (*Opuntia ficus indica*.inermis) cladodes on digestion, growth and intramuscular fatty acid composition in sheep and goats, Small Ruminant Research, 87: 9-16.
32. Tegegne F, K.J. Peters and C. Kijora, 2005. Effects of increasing kevels of cactus pear Opuntia ficus indica. Conference on International Agricultural Research for Development. Stuttgart-Hohenheim, pp: 11-13.
33. Degu, A. and M.B. Solomon, 2010. Supplementation of isonitrogenus oil seed cakes in cactus (*Opuntia ficus* indica) tef straw (Eragrostis tef based feeding of Tigray highland sheep cactus. 7 th International Congress in Morocco, (Agadir), pp: 17 -22.
34. Frati, A.C., 1992. Medical implication of prickly pearcactus. In: Proc. 3rd Annual Texas pricklypear council. Eds: Felkar P, Moss LR, 24-25July, Kingsville, Texas, pp: 29-34.
35. Wolfram, R.M., H. Kritz, P. Schmid, Y.E. fthimiou, Y. Stamatopoulos and H. Sinzinger, 2002. Effect of prickly pear (Opuntia robusta) onglucose- and lipid-metabolism in non diabetics with hyperlipidemia, Wr klin Wschr, 114: 840-846.
36. Fernandez, M.L., E.C. Lin, A. Trejo and D.J. McNamara, 1992. Prickly pear (*Opuntia* sp.) pectin reverses low ensity lipoproteinreceptor suppression induced by hypercholesterolemic diet in guinea pigs. J. Nutrition, 122: 2330-2340.
37. Kritchevsky S.A. Tepper, Satchithanandasm. M. Cassidym and G.V. Vahouny, 1988. Dietary fiber supplements: effects on serum and liver lipids and on liver phospholipid composition in rats, Lipids, 23: 318-321.
38. Miettinen, T.A. and S. Tarpila, 1977. Effect of pectin on serum cholesterol, fecal bile acids and biliary lipids in normolipidemic and hyperlipidemic individuals. Clinical. Chemical. Acta, 79: 471-477.
39. Ney, D.M., B. Lasekanj and L. Shinnickf, 1988. Soluble fiber tends to normalize lipoprotein composition in cholesterol-fedrats. Nutrition, 118: 1455-1462.
40. Chilliard, Y., F. Bocquier and M. Doreau, 1998. Digestive and metabolic adaptations of ruminants to undernutrition and consequences on reproduction. Reproduction. Nutrition. Developpement, (38 :2): 131-152.
41. Suash-au prauseennivasan, S. and S. Ignacimuthu, 2007. Cinnamaldehyde-A potential antidiabetic agent. J. Phytomedecine, 14: 15-22.
42. Frati Munari, A.C., O. Vera Lastra and C.R. Ariza Andraca, 1992. Evaluation of nopal capsules in diabetes mellitus. Gaceta Medecine Mexico, 128: 431-436.
43. Laurenz, J.C., C.C. Collier and J.O. Kuti, 2003. Hypoglycaemic effect of Opuntia lindheimeri Englem. in a diabetic pig model. Phytotherapie. Research, 17: 26-29.
44. Van Bennekum, A., D.V. Nguyen, G. Schulthess and M.C. Hauser Hand Phillips, 2005. Mechanisms of cholesterol-lowering effects of dietary insoluble fibers: relation ship with intestinal and hepatic cholesterol parameters. British J. Nutrition, 94: 331-337.
45. Lee, J.C. and K.T. Lim, 2000. Effects of cactus and ginger extracts as dietary antioxidants on reactive oxidant and plasma lipid level. Food Sciences. Biotechnology, 9: 83-88.
46. Healy, P.J. and R.H. Falk, 1979. Values of some biochemical constituents in the serum of clinically-normal sheep. Australia. Veterinary. J., 50: 302-305.