RESEARCH

EVALUATING THE USE OF *Atriplex nummularia* HAY ON FEED INTAKE, GROWTH, AND CARCASS CHARACTERISTICS OF CREOLE KIDS

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There is a surplus of *Atriplex nummularia* Lindl. grazing that can be used as animal feed. This material was harvested to assess the effects on intake, growth, and carcass characteristics of kids. *Atriplex* replaced alfalfa hay (*Medicago sativa* L.) in a proportion of 0%, 10%, 20%, 30%, and 40% for 60 creole kids weighing 13 kg and was assigned to the diets in a completely randomized design. The process was conducted from March to May. Two males and two females were used from each group to evaluate individual nutrient intake. Height at withers, thoracic diameter, and weight change were evaluated in all the animals. The carcasses of four females per group were evaluated. Offered and rejected hay diet samples were chemically analyzed. *Atriplex* hay crude protein (CP), metabolizable energy (ME), chlorine (Cl), and sodium (Na) contents were 20.20%, 1.99 Mcal kg^{-1}, 4.78%, and 6.47% respectively. Hemicellulose (Hc), ash intake, height at withers, thoracic diameter, and carcass component, except for the kidney, were not different ($P > 0.05$) among treatments. Over 20% of *A. nummularia* hay content in the diet caused an increase in mineral consumption ($P < 0.05$). Total body weight gain decreased ($P < 0.05$) by adding 20% or more *A. nummularia* hay content in the diet. However, adding up to 20% of *A. nummularia* hay in the diet did not produce a negative effect and higher percentages decreased weight gains attributable to the high Na and Cl content.

Key words: *Atriplex nummularia*, goats, hay.

There are about 65000 ha of *Atriplex repanda* (Sereno), *Atriplex nummularia* Lindl., and *Acacia saligna* (Labill.) H. L. Wendl. plantations in the coastal area of the Coquimbo Region, Chile. They were planted in 1976 to revegetate degraded and overgrazed areas and provide forage for goats and sheep during the annual dry period. Most of these plantations consist of *A. nummularia*. Drought resistance is a characteristic that allows it to be grazed during the annual dry period when there are no other available forage resources (Ben Salem *et al*., 2010). The chemical composition of *A. nummularia* edible dry matter (EDM) consists of 10.3 to 25.9% crude protein (CP) and 17.9 to 35.4% ash as evaluated in different countries (Ben Salem *et al*., 2010). In Chile, Meneses and Squella (1996) reported 16.3% CP and 22.9% ash. *Atriplex nummularia* also contains high concentrations of S, Mg, Ca, P, Na, and KCl (Aganga *et al*., 2003). In some cases, these components can decrease food consumption and produce mineral imbalances and improve product quality, such as wool production, in other cases due to S concentration (Norman *et al*., 2004; 2008).

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Consumption of *A. nummularia* by sheep is between 37 to 115g DM kg^{-1} $BW^{0.75}$, which is considered low because of the high salt content, higher drinking water requirements (Masters *et al*., 2005a; 2005b), and *Atriplex* non-protein nitrogen, which requires higher energy for microorganism metabolism (Ben Salem, 2002a). Sheep nutritional supplementation with one third of their energy requirements improves body weight gain, body condition, and wool production (Norman *et al*., 2008). Thomas *et al*. (2007) also concluded that animals grazing on *A. nummularia* require energy supplementation more than any other kind of supplementation.

Many stockbreeders graze their *A. nummularia* plantations with sheep and goats before the rainy season in the summer and fall. Others do not apply this method; consequently, crops increase in size and limit small ruminant grazing. This causes an excess of unconsumed leaves that are wasted. Another reason for unconsumed leaves is their low acceptability. The high mineral content and other chemical components limit its consumption (Aganga *et al*., 2003). This species needs to be harvested or grazed at least once a year to stimulate annual growth; otherwise, there will be leaf loss and decrease in its production (Wilmot and Norman, 2006). Another advantage of removing excess material is increasing vegetation coverage under its canopy projection and herbaceous dry matter (DM) production (Lailhacar and Torres, 2001).

The excess of *Atriplex* leaves can be harvested, dried, stored, and used to feed animals that do not have access to this forage during the dry period. This resource combined with other ingredients can also be a good feeding alternative for sheep and goats during the summer and fall by achieving the dilution of salts in a balanced diet and improving animal consumption and nutrient level. The objective of this study was to evaluate the effect on diet intake, growth, and carcass characteristics by including *Atriplex nummularia* in a basal diet of alfalfa hay (*Medicago sativa* L.) offered to creole kids under stabling conditions.

MATERIALS AND METHODS

Atriplex nummularia leaves were harvested on January 4 and 5 from a 10-yr-old plantation located in El Tangue Ranch (30°31'30.27" S, 71°27'42.76" E) in the Coquimbo Region, Chile. The harvested material consisted of about 14 000 kg of green material that was transported to the Santa Cristina farm (30°20'51.38" S, 71°83'32.09" E). Once there, it was distributed for dehydration over a Rachel net located on a wire net (3 × 12 m) and both nets were supported by six posts 1 m high. Material samples were obtained every 2 d to determine DM according to AOAC (1990) and control the dehydration process until it reached 20% humidity. After the dehydration process, *A. nummularia* and alfalfa hay were chopped with a 5 cm screening mill for the experimental diets. *Atriplex nummularia* hay was mixed with alfalfa hay in a mixer at 10%, 20%, 30%, and 40% ratios.

Sixty goat kids, 2-mo-old and 13 kg LW, were randomly selected from a dairy farm located nearby. These animals were submitted to a 21 d pre-experimental period in a community pen with only an alfalfa hay basal diet with 40% *A. nummularia* offered *ad libitum* to get used to the *Atriplex* intake. Animals were assigned to five experimental groups each consisting of three males and nine females and maintained in a community pen for 61 d. Two females and two males were selected from each group to evaluate individual intake in an individual pen. Weighed feed and water in buckets were offered. Experimental diets were offered twice a day at 09:00 and 17:00 h and were adjusted daily in each group so that there would always be at least 10% rejection to avoid selection in diet consumption.

Experimental measurements began in March with daily evaluations of the amount of food offered and rejected. The samples obtained in the individual and community groups were oven-dried at 60 °C for 62 h (AOAC, 1990). At the end of the trial, all rejected samples were mixed to obtain only one sample from each experimental group for chemical analysis. These samples, offered and rejected *A. nummularia* and alfalfa hay, were sent to the Remehue Laboratory, Osorno for chemical analyses. Dry matter (DM) content was oven-dried at 105 °C by forced air for 24 h. Crude protein (CP) was obtained as N by micro Kjeldahl analysis and then calculated as 6.25 × N content (AOAC, 1990). Metabolizable energy (ME) was determined by organic matter digestibility estimation (Tilley and Terry, 1963). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were measured with a Fiber digester (Labconco, USA) and lignin by the 72% sulfuric acid method (ADL). Hemicellulose and cellulose were obtained by the differences between NDF ADF and ADF ADL, respectively (van Soest, 1963). Ash was determined by ashing at 550 °C for 4 h (AOAC, 1990). With these data it was possible to calculate the amount of nutrients consumed as the difference between offered and rejected food in both individual and community groups.

Body weight, thoracic diameter, and height at withers were evaluated every 7 d. At the end of the growth evaluation, four females were slaughtered in the field after a 12 h tare (Meneses *et al*., 2004). Live weights were obtained before slaughtering and weight of blood, skin, autopods, full and empty digestive tract, heart, liver, kidney, and lungs plus trachea, warm and cold carcass weight with and without the head, and eye loin area between the 12th and 13th rib was measured by copying the muscle perimeter on transparent paper and then determining the area with a planimeter (Digital Koizumi Lacom kp-80, Japan) according to the description by López *et al*. (1992) and Meneses *et al*. (2004). All this data made it possible to calculate the empty live weight (animal weight minus ruminal content), commercial yield (carcass weight/live body weight), true yield (carcass weight/empty body weight), red stripping yield (heart, liver, and lung plus trachea), head yield, empty digestive tract, skin, and autopods as the ratio between the respective component weight and empty weight (López *et al*., 1992).

Data were analyzed with ANOVA by the SAS GLM procedure (SAS Institute, 1998) in a random design with five treatments and four replicates for the intake variable, 12 replicates for growth evaluation, and four replicates for carcass measurement. Data were subjected to ANOVA and Duncan's test (Steel and Torrie, 1980) to establish differences among treatments. Different regression models were also evaluated to determine a better relationship for kid body total gain and *A. nummularia* inclusion percentage.

RESULTS AND DISCUSSION

Chemical composition of *Atriplex nummularia* hay

The chemical composition of *A. nummularia* (Table 1) depends on EDM, i.e., the leaf and stem proportion obtained from the harvested material (Norman *et al*., 2004). Although, in this case, the leaf proportion represents half of total DM (Table 2) and leaf CP content is generally higher than stem CP content (Jahn *et al*., 2003), this component is in the 10% to 25% range reported by Ben Salem *et al*. (2010) and is superior to the raw CP content

Table 1. Chemical analyses of *Atriplex nummularia* and alfalfa hay.

	Hay	
Nutrients	Alfalfa	*A. nummularia*
Dry matter, %	89.70	88.10
Crude protein, %	16.00	20.20
Neutral detergent fiber, %	41.40	35.20
Acid detergent fiber, %	30.70	17.10
Hemicellulose, %	10.70	18.10
Lignin, %	8.10	5.10
Cellulose, %	22.60	12.00
Ash, %	9.90	28.30
Metabolizable energy, Mcal	2.21	1.99
Chloride, %	0.45	4.78
Sodium, %	0.18	6.47

Table 2. Leaf and stem proportions of *Atriplex nummularia* hay.

Components	Percentage
Leaf	54.44
Stem 2-4 mm	7.04
Stem 4-6 mm	14.52
Stem 6-8 mm	24.19

in the alfalfa hay that was used. The high ash content of *Atriplex* is a result of the high Na and Cl content. The species of the genus *Atriplex* is characterized by its high salt content as well as its high levels of S, Mg, Ca, P, and other chemical components (Masters *et al*., 2007). The Cl and Na content in *A. nummularia* are 10.6 and 36 times more than the Cl and Na content in alfalfa, respectively. The ME in *A. nummularia* is 10% lower than alfalfa ME. Ben Salem *et al*. (2002b) indicate that *A. nummularia* exhibits low energy content, which could be a limiting factor to cover animal requirements. Norman *et al*. (2008) establish that energy content does not cover the lamb's energy requirements and calculations obtained in this research found that the amount of energy is limiting to some extent. The other chemical components were similar to those reported by the aforementioned authors.

Nutrient intake

Dry matter, CP, NDF, ADF, lignin, and ME intake were not significantly different ($P < 0.05$, Table 3). According to NRC (1981), nutrient requirements were 30.64 g and 0.781 Mcal for CP and ME, respectively, for these animals; furthermore, according to NRC (1981) recommendations, ingested nutrients were very similar for CP and limiting for ME in 21.5%, 23.34%, and 23.79% for treatments with 10%, 20%, 30%, and 40% *A. nummularia*, although statistical analysis showed no significant differences in energy consumption. The increase of ash ingestion is determined by its high content in *A. nummularia* and limits consumption of dry material (Norman *et al*., 2004).

In the evaluation of the rejected diet component (Table 4), more *Atriplex* leaves than stems in feeding were found for all *A. nummularia* treatments and both numbers were higher than the rejected leaves and stems of alfalfa hay.

Thoracic diameter and height at withers

Thoracic diameter and height at withers did not show any significant differences (Tables 5 and 6). During the first week, evaluated thoracic diameter showed a tendency to decrease in size, which can be attributed to stress produced by the beginning of the trial, although these animals had an acclimatization period in a community paddock with a higher percentage of *A. nummularia* in their diet.

By the end of the evaluation period, thoracic diameter had a slight tendency to decrease with the increasing inclusion of Atriplex hay in the diet. Unlike thoracic diameter, height at withers always exhibited growth because thoracic diameter depends on muscle volume and fat accumulation and height depends on bone length.

Weight gain

Partial body weight variations, not included in this text, did not show any differences ($P > 0.05$). However, the treatment produced differences in body weight gain ($P < 0.05$) at the beginning and end of the evaluation with negative weight gains (Table 7, Figure 1).

At the beginning, there was probably an adaptation effect to the diets even though there was an acclimatization

Table 4. Rejected component as percentage of diet with different proportions of *Atriplex nummularia* hay.

A. nummularia	Alfalfa hay	*A. nummularia* hay leaf	*A. nummularia* hay stem
		%	
0	100.0	0.0	0.0
10	40.0	46.7	13.3
20	30.8	38.5	30.8
30	23.3	40.0	36.7
40	23.4	29.7	46.9

Table 3. Total nutrient intake of kids fed different proportions of *Atriplex nummularia* hay.

A. nummularia	DM	CP	NDF	ADF	Hc	Celul	Lig	Ash	ME
%					kg				Mcal kg^{-1}
0	72.8	12.5	33.8	25.2	8.7a	18.5a	6.6	7.8b	2.21
10	65.8	12.7	30.7	24.7	5.8b	18.5a	6.2	7.9b	2.19
20	66.8	11.7	30.7	23.9	6.8b	17.3ab	6.7	9.3ab	2.17
30	65.9	13.3	30.3	21.0	9.2a	14.8a	6.1	9.8a	2.14
40	66.2	12.0	31.2	21.4	9.4a	15.8b	5.6	11.1a	2.12
CV, %	14.0	13.9	14.0	14.00	14.3	14.0	14.0	14.3	13.96
Pr > F	0.81	0.73	0.79	0.28	0.00	0.02	0.47	0.01	0.63

DM: Dry matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber; Hc: hemicellulose; Celul: cellulose; Lig: lignin; ME: metabolizable energy. CV: coefficient of variation.
Means in column with different letters differ according to Duncan's test ($P < 0.05$).

Table 5. Thoracic diameter (cm) of creole kids fed a diet with different proportions of *Atriplex nummularia*.

A. nummularia	Dates								
	March			April			May		
(%)	12	19	26	2	9	16	23	30	7
0	58.17	54.67	54.75	56.92	59.08	60.33	63.18	64.18	66.09
10	58.91	56.46	55.46	57.36	59.55	60.44	61.27	61.82	62.55
20	59.50	59.25	55.50	57.50	58.75	62.27	62.55	63.00	64.36
30	60.33	57.33	55.67	57.33	58.75	59.33	60.33	60.75	61.58
40	59.83	59.08	56.92	58.67	60.08	60.58	61.08	61.33	60.67
Pr > F	0.99	0.82	0.99	1.00	1.00	0.98	0.97	0.95	0.79
CV, %	19.34	18.45	20.01	20.09	20.18	18.72	18.03	17.69	17.85

CV: Coefficient of variation.

Table 6. Height at withers (cm) of creole kids fed a diet with different *Atriplex nummularia* proportions.

A. nummularia	Dates								
	March			April			May		
(%)	12	19	26	2	9	16	23	30	7
0	48.2	50.3	51.0	51.2	51.3	51.8	52.0	51.3	51.8
10	47.8	49.4	50.3	50.9	51.5	51.9	51.8	52.6	52.5
20	48.8	49.7	50.3	50.8	51.3	52.1	52.5	52.8	51.9
30	48.9	49.2	49.8	50.7	51.4	51.9	52.5	53.0	52.6
40	46.9	48.7	51.2	51.7	51.9	53.3	54.1	55.3	53.9
Pr > F	0.9	0.83	0.79	0.92	0.98	0.76	0.46	0.12	0.55
CV, %	8.03	6.82	5.88	5.83	5.78	5.92	6.11	6.65	6.27

CV: Coefficient of variation.

Table 7. Weekly weight and total gain of kids fed with different proportions of *Atriplex nummularia* hay.

A. nummularia	Dates									Total
	March			April			May			
(%)	12	19	26	2	9	16	23	30	7	gain
%	kg									
0	-0.89b	0.05a	0.50	0.55	0.25	0.25	0.27	0.43a	-1.24b	1.39a
10	-0.59ab	-0.29a	0.51	0.53	0.22	0.20	0.15	0.14b	-1.30b	0.88ab
20	-0.04a	-0.90b	0.50	0.29	0.30	0.06	0.18	0.27ab	-0.19ab	0.57b
30	-0.72ab	-0.40ab	0.37	0.39	0.18	0.20	0.13	0.20b	0.08ab	0.32b
40	-0.04ab	-0.50ab	0.45	0.29	0.15	0.15	0.05	-0.21c	0.77a	0.18b
Pr > F	0.05	0.02	0.88	0.25	0.51	0.38	0.27	0.01	0.12	0.015
CV, %	-160.4	-161.9	83.4	91.5	93.6	130.8	145.4	133.4	-633.4	137.8

CV: Coefficient of variation.
Means in a column with different letters differ according to Duncan's test (P < 0.05).

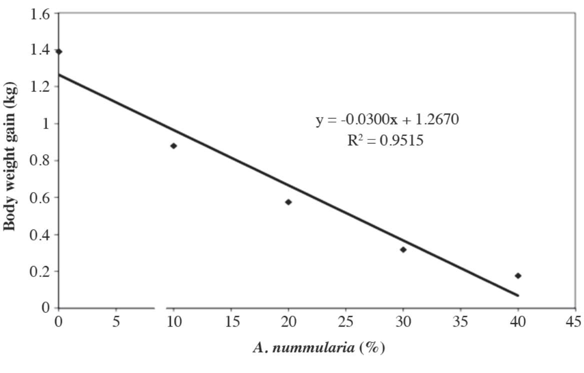

Figure 1. Regression of kid body total gain and *Atriplex nummularia* included in alfalfa basal diet.

period of about 21 d. Subsequently, weight stabilized until the last assessment, when the weekly weight decreased again for the first 3 treatments with no explanation for these losses. As previously stated, all the animals consumed the same nutrient contents, except for the high ash consumption due to an increase of *Atriplex* hay in the diets and a lack of metabolizable energy, which can explain the variations. It is also possible that there is a lower digestibility of the diet due to added *A. nummularia* and the effect of salt content in the ruminal environment by rumen osmolality changes. Masters *et al*. (2005b) reported depressed feed intake and digestibility of halophyte shrub intake. This will therefore decrease growth rates or weight loss.

Analysis of the cumulative weight gain in the whole trial period results in significant differences (Table 7), which can be attributed to small differences that accumulate over time due to energy limitation, DM consumption, high ash, and Cl and Na intake. The latter can cause mineral imbalance (Masters *et al*., 2007) when consumption is over a long period of time. Ben Salem *et al*. (2010) state that a large proportion of *A. nummularia* non-protein N and ruminal protein synthesis require energy to synthesize microbial protein or else ammonia is absorbed and excreted in the urine. However, the differences found in this research are not very extensive and adding an energy source can improve the productive parameters. Norman *et al*. (2008) improved body and weight conditions and wool production by supplementing with grain and reduced weight and body condition losses of sheep fed with *A. nummularia*. Ben Salem *et al*. (2002a; 2002b) also succeeded in increasing the productive response by increasing diet energy content.

Although most of the diet chemical components showed no significant differences, the total weight gain of kids fed *Atriplex* did have statistical differences when 20% *Atriplex* was included in the diet. The evaluation trial period was 2 mo and the effect was inconsistent and cumulative; *Atriplex* feeding over a short period of time probably has a low effect for this reason.

The regression analysis is statistically significant ($P < 0.05$) for a lineal model of kid body total gain and *A. nummularia* inclusion percentage.

Carcass composition

The ANOVA of carcass and components showed no significant effect on these parameters, except for kidney weight, commercial yield, and autopod performance ($P > 0.05$ Tables 8 and 9). No statistical differences are expected given the results obtained from the weight, height, and thoracic diameter variations.

Table 8. Carcass component of kids fed with different proportions of *Atriplex nummularia* hay.

Components	*A. nummularia* (%)						CV
	0	10	20	30	40	Pr > F	(%)
Slaughter weight, kg	15.71	14.53	15.58	16.29	16.21	0.933	20.02
Carcass weight							
Warm, with/head	7.23	6.63	7.13	5.86	6.18	0.55	20.21
Warm, without/head	6.21	5.67	6.23	4.98	5.30	0.44	19.53
Cold, without/head	6.26	5.72	6.28	5.04	5.35	0.45	19.35
Head weight, kg	1.01	0.87	0.91	0.79	0.88	0.56	20.22
Blood weight, kg	0.91	9.78	0.82	0.69	0.75	0.57	23.05
Skin weight, kg	1.20	1.02	0.89	0.90	0.99	0.29	20.93
Autopod weight, kg							
Right hand	0.10	0.097	0.102	0.112	0.080	0.39	22.88
Left hand	0.10	0.097	0.112	0.102	0.077	0.33	23.41
Digestive system, kg							
Full weight, kg	5.33	4.68	5.48	5.54	5.98	0.74	24.78
Empty weight, kg	3.07	2.72	3.00	2.57	2.76	0.79	22.69
Ruminal content weight, kg	2.26	1.96	2.48	2.98	3.21	0.16	20.01
Heart weight, kg	0.07	0.07	0.09	0.08	0.07	0.74	34.37
Lung weight, kg	0.18	0.14	0.19	0.17	0.13	0.15	21.65
Right kidney weight, kg	0.06a	0.05a	0.05a	0.05ab	0.03b	0.03	20.91
Left kidney weight, kg	0.06a	0.05a	0.05a	0.05ab	0.03b	0.03	20.91
Pancreas weight, kg	0.06	0.04	0.05	0.04	0.04	0.32	21.00
Liver weight, kg	0.26	0.22	0.30	0.22	0.22	0.19	22.72
Eye loin, cm^2	5.40	5.09	5.03	4.14	4.24	0.33	20.91

CV: Coefficient of variation.
Means with different letters in a row are significantly different ($P < 0.05$).

Table 9. Carcass component yields of kids fed with different proportions of *Atriplex nummularia*.

Yiel (%)		*A. nummularia* (%)					CV
	0	10	20	30	40	Pr > F	(%)
Commercial	39.95a	39.58a	40.48a	31.22b	37.71ab	0.024	11.66
Truth	46.62	45.71	47.84	38.38	42.67	0.278	14.33
Red remains	0.67	0.57	0.72	0.59	0.53	0.31	21.75
Head	7.518	7.013	6.95	6.00	7.01	0.45	16.05
Digestive tract	22.71	21.46	23.24	19.47	22.02	0.119	15.80
Skin	8.90	8.12	6.77	6.85	7.93	0.12	15.80
Autopod	3.11a	3.02a	3.22a	3.12a	2.23b	0.03	14.09

CV: Coefficient of variation.
Means with different letters in a row are significantly different ($P < 0.05$).

The effect of kidney weight could be linked to the fact that Cl and Na consumption for the 30% *A. nummularia* diet was 3.87 and 10.78 times the control intake, respectively. These values are 4.85 and 14.98 times the control intake, respectively, in the case of the 40% treatment and excess salt is eliminated by the kidney.

The commercial yield could have been influenced by the lower empty weight of the 30% and 40% *A. nummularia* treatments, although this component did not show any statistical differences. In the case of autopods, the inclusion of 40% *Atriplex* hay was significantly less than the other treatments and the cumulative effect could have caused a difference in the performance of this component.

There are no recent publications about the characterization of native goat kid carcasses in the country. Meneses *et al*. (2004) present values of creole animals that are higher than those found in this paper, but the animals were slaughtered at heavier weights.

CONCLUSIONS

A 10% proportion of *A. nummularia* hay added to an alfalfa hay basal diet has no effect on goat kid total weight gain. Higher proportions limit this parameter. Thoracic diameter and height at withers were not affected by including *A. nummularia* to an alfalfa hay basal diet. The energy contribution of *A. nummularia* apparently causes limitations. Therefore, energy supplementation is important to obtain positive results. Except for higher kidney weight, none of the *A. nummularia* hay proportions used in the diets had any effect on goat kid carcasses. Moreover, it is necessary to indicate that the consumption of Cl and Na is very high.

Evaluación del uso de heno de *Atriplex nummularia* en el consumo de alimento, crecimiento y características de canal de cabritos criollos. Existe excedente del pastoreo de *Atriplex nummularia* Lindl. que puede ser usado en la alimentación animal. Este material fue cosechado para evaluar el efecto en el consumo, crecimiento y en las características de canal de caprinos. El Atriplex fue entregado en reemplazo de heno de alfalfa (*Medicago sativa* L.) en una proporción de 0, 10, 20, 30 y 40%, a 60 crías criollas, de 13 kg de peso, asignadas a las cinco dietas, en un diseño completamente al azar, entre marzo y mayo. El consumo individual se evaluó en dos hembras y dos machos por grupo. La altura a la cruz, variación de peso y diámetro de tórax fueron evaluados en todos los animales. Las canales se evaluaron en cuatro hembras por grupo. Muestras de heno, dietas ofrecidas y rechazadas fueron analizadas químicamente. El contenido de proteína cruda (PC), energía metabolizable (EM), Cl y Na del Atriplex fue de 20,20%, 1,99 Mcal kg^{-1}, 4,78 y 6,47%, respectivamente. El consumo de hemicelulosa (Hc), cenizas (Cen), diámetro torácico, altura a la cruz, y componentes de la canal, exceptuado los riñones, no fueron diferentes (P > 0,05) entre tratamientos. Por sobre 20% de *A. nummularia* en la dieta se incrementa el consumo de minerales (P > 0,05). La ganancia total de peso disminuyó (P < 0,05) con la incorporación de 20% o más de Atriplex. La incorporación de hasta 20% de Atriplex no provoca efectos negativos, mayores porcentajes disminuyen las ganancias de pesos atribuibles al alto contenido de Na y Cl.

Palabras clave: *Atriplex nummularia*, caprinos, heno.

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