Impact of *Lippia palmeri* S. Watson during kid suckling and growth

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ABSTRACT

Objective: raising kids is a fundamental activity in goat production, since their development is the source of replacements for the dairy herd or the sale of meat. Therefore, the impact in the kids' growth of adding *Lippia palmeri* S. Watson oregano to the goat diet was evaluated.

Materials and methods: a total of 17 kids born from mothers who consumed the four diets (treatments) were evaluated. They were divided as follows: 6 kids in T1 (ASINC with ORE); 5 kids in T2 (ASINC without ORE); 3 kids in T3 (SINC without ORE); and 3 kids in T4 (SINC with ORE). The weight gain (kg) and daily milk consumption (kg) variables were evaluated for 60 days.

Results: no significant differences were found ($p>0.05$) between treatments, showing an average daily weight gain of 0.0895±0.018 kg in T1 (ASINC with ORE), 0.0892±0.026 kg in T2 (ASINC without ORE), 0.0934±0.035 kg in T3 (SINC without ORE), and 0.118±0.026 kg in T4 (SINC with ORE). Meanwhile, the average daily milk consumption was 0.509±0.240 kg in T1 (ASINC with ORE), 0.580±0.205 kg in T2 (ASINC without ORE), 0.553±0.190 kg in T3 (SINC without ORE), and 0.717±0.202 kg in T4 (SINC with ORE).

Conclusions: no treatment was significantly higher than the others. A significant and positive correlation ($r=0.879$, $p<0.0001$) was detected between the two variables under study.

Keywords: Growth, kids, *Lippia palmeri*, consumption, nutrient synchrony.

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INTRODUCTION

Maintaining a constant and increasing development is fundamental for raising goats, because it will allow them to reach the expected weight for sale or weaning. General considerations for weaning include objective of use, weight (8-10 kg), age (6-8 weeks), and the ability to consume solid foods. Therefore, management strategies that guarantee the achievement of these objectives allow the farm to get efficient economic results (Gómez-Gómez *et al.*, 2019). In livestock research, the growth analysis of ruminant offspring is

an important object of study. The diet received by developing animals is related to their genetic behavior and the efficiency of the foods used in their nutrition, which impact the growth rate and maximum use of food by the species (Galina *et al.*, 2009). The birth of kids is an important factor to predict the future performance of goat offspring and to decrease the herd mortality percentage; Abbas *et al.* (2020) have documented that the mother's diet before and after childbirth influences the development rate. Accordingly, this document shows the weight gain and milk consumption of kids from different treatments, resulting from the inclusion of oregano (*Lippia palmeri* S. Watson) in the diet and its nutrient synchrony in the feeding of mother goats.

MATERIALS AND METHODS

Study area

The research was carried out at "Rancho El Palmar de Abajo" (23° 38' 02" N and 110° 17' 05" W, 200 m.a.s.l.), located in the sub-delegation of La Matanza, municipality of La Paz, Baja California Sur, Mexico. The climate at the study site is desert arid with an average monthly temperature of 21.2 °C in summer and 9 °C in winter. The average annual precipitation is 200 mm and the average annual temperature is 28 °C. The main rainy season lasts from July to September, although occasional winter rains have been reported (Ramírez *et al.*, 2011). The dry season lasts from February to June (Troyo *et al.*, 2014).

Composition of the diet of mother goats

Table 1 shows the composition of the diet of mother goats, including the synchrony index of each ingredient. The protein-energy synchrony in the diet was determined, as described by Sinclair *et al.* (1993).

Table 1. Nutritional composition of diets.

Ingredient (% in Diet)	Treatment			
	T1	T2	T3	T4
	ASINC with oregano	ASINC without oregano	SINC without oregano	SINC with oregano
Alfalfa meal	0.5	9	1.1	4.9
Corn, ground	46	44	36.1	32.93
Soybean meal	0	0	9.1	7.6
Bean straw	49.5	45.9	53.6	51.8
Lippia palmeri (oregano)	2.6	0	0	2.6
Urea	1.4	1.1	0.1	0.17
Total	100	100	100	100
SI	0.69	0.689	0.71	0.71
DM (%)	89.21	89.44	90.59	90.57
CP (%)	11.0	11.1	11.0	11.1
ME (Mcal ME/kg)	3.38	3.38	3.33	3.21

SI = diet synchrony index: ingredient (%) = percentage of food in the diet; DM = dry matter (%); CP = crude protein (%); and ME = metabolizable energy (Mcal/kg, dry basis).

Kid growth evaluation

The growth and development of kids was analyzed using their weight as a reference. They were separated from the mother the previous night. Their empty weight was measured in the morning and they remained with the mother until the udder clearly had no more milk. After this step, the kids were weighed again to determine their milk consumption by weight difference; they were then separated again from their mother until the afternoon (approximately 9 hours). This procedure was repeated every day for 60 days (Benson *et al.*, 1999). Milk consumption (MC) and daily weight gain (DWG) were calculated with the following formulas (Benson *et al.*, 1999):

$$MC = EW - WAS \quad (1)$$

Where: MC = milk consumption (kg); EW = kid empty weight (kg); WAS = kid weight after suckling (kg).

$$DWG = EKW - EW \quad (2)$$

Where: DWG = daily weight gain (kg); EKW = empty kid weight day before (kg); EW = kid empty weight (kg).

Statistical analysis

A repeated measurements statistical model was used: a one-way analysis of variance (ANOVA) test was carried out for the milk consumption and weight gain variables (Galina *et al.*, 2009), carrying out the statistical analysis in the SPSS version 22.0 for Windows statistical package (IBM, 2013).

RESULTS AND DISCUSSION

Table 2 shows the results of the normality test of the data and the one-way ANOVA for each measured variable: the data meet the assumption of homogeneity of variances and normality. The ANOVA obtained non-significant values between treatments, for the milk consumption (kg) (p=0.611) and weight gain (p=0.399) variables. Therefore, oregano and nutrient synchrony do not have a significant impact on the development of kids.

Table 3 illustrates the results of average milk consumption per treatment and their totals. On the one hand, T4 (SINC with ORE) is observed with the highest milk consumption and

Table 2. Results of the analysis of the observation of the 17 kids.

Variable	Levene's test		Kolmogorov-Smirnov Test[a]		Shapiro-Wilk Test		ANOVA	
	Statistic	p Value	Statistic	p Value	Statistic	p Value	Statistic	p Value
Milk intake (kg)	0.345	.793	0.130	.200*	0.972	.846	0.626	.611
Weight gain (kg)	0.482	.701	0.090	.200*	0.982	.974	1.062	.399

[a] With Lilliefors correction. [*] This is a lower limit of true significance.

Table 3. Descriptive statistics of milk consumption and weight gain (kg), daily and total averages for the 60 days, per treatment (Trt) n = number of kids.

Variable	Treatment	n	Mean	Standard deviation	Standard error	Minimum value	Maximum value
Average daily milk intake (kg)	1	6	0.5096	0.24081	0.09831	0.2053	0.8576
	2	5	0.5809	0.20515	0.09175	0.3070	0.7528
	3	3	0.5534	0.19010	0.10975	0.3825	0.7582
	4	3	0.7178	0.20201	0.11663	0.5917	0.9508
	Total	17	0.5750	0.20926	0.05075	0.2053	0.9508
Average total milk intake (kg)	1	6	30.5750	14.44840	5.89853	12.3150	51.4580
	2	5	34.8528	12.30928	5.50488	18.4200	45.1670
	3	3	33.2060	11.40576	6.58512	22.9490	45.4890
	4	3	43.0703	12.12070	6.99789	35.4990	57.0500
	Total	17	34.5025	12.55560	3.04518	12.3150	57.0500
Average daily weight gain (kg)	1	6	0.0895	0.01815	0.00741	0.0675	0.1163
	2	5	0.0892	0.02683	0.01200	0.0543	0.1228
	3	3	0.0934	0.03507	0.02025	0.0592	0.1292
	4	3	0.1188	0.02632	0.01520	0.1005	0.1489
	Total	17	0.0952	0.02553	0.00619	0.0543	0.1489
Average total weight gain (kg)	1	6	5.3675	1.08915	0.44464	4.0500	6.9750
	2	5	5.3510	1.61011	0.72006	3.2600	7.3700
	3	3	5.6050	2.10404	1.21477	3.5490	7.7540
	4	3	7.1250	1.57898	0.91162	6.0300	8.9350
	Total	17	5.7147	1.53152	0.37145	3.2600	8.9350

greatest weight gain; on the other hand, treatments T1 (ASINC with ORE), T2 (ASINC without ORE), and T3 (SINC without ORE) had very close results in both variables.

Figure 1 shows the temporal evolution of the daily milk consumption of kids. Treatments with *Lippia palmeri* had similar initial values: 0.238±0.21 kg (T1), 0.347±0.41 kg (T4), and 0.282±0.135 kg (T3). Meanwhile, T2 had the highest value on day 1 of measurement (0.526±0.209 kg). T4 (SINC with ORE) showed similar values to the other treatments until day 31. In this period, its values were close to 0.617±0.298 kg and afterwards it had the highest levels, compared to the other treatments, reaching its maximum consumption on day 37 (0.995±0.293 kg) and a similar average value on day 49 (0.99±0.316 kg). The aforementioned high levels and low values fluctuated in this treatment (T4), varying from 0.70±0.175 kg on day 40 to 0.78±0.489 kg on day 54 and ending with the highest levels on the study: 0.703±0.234 kg and 0.667±0.205 kg on days 59 and 60, respectively.

Figure 2 shows the weight gain evolution of the kids per treatment during the 60 days of the experiment. Although no significant differences were recorded between treatments, the noticeable fluctuation caused some growth peaks, since T1 (ASINC with ORE) reported the lowest value per treatment on day 13 (0.012±0.018 kg), while T2 (ASINC without ORE) showed equally low values on day 34 and 38 (0.006±0.013 kg). For its part, T3 (SINC without ORE) had values of 0 on days 25, 41 and 45. Finally, T4 (SINC with ORE)

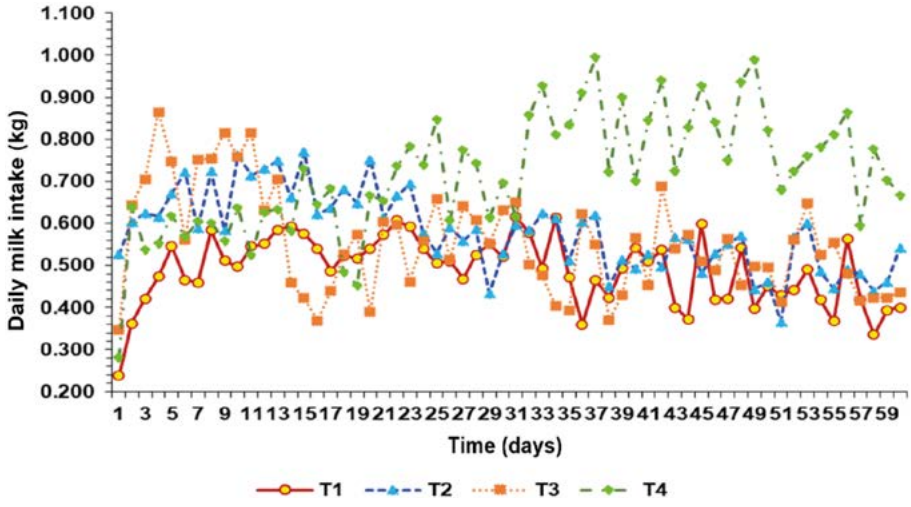

Figure 1. Average daily milk consumption (kg) per treatment.

recorded a value of 0 in weight gain on day 2. Meanwhile, the highest weight gain values in the experiment were, from lowest to highest: T1 on day 36 (0.187±0.129 kg); T2 on day 6 and 53 (0.24±0.212 kg); and, finally, T4 on day 3 (0.34±0.202 kg). At the end of the experiment (day 60), T1 showed the highest value (0.156±0.122 kg), followed by T2 (0.116±0.144). T3 was the treatment with the lowest value at the end of the experiment (0.017±0.004 kg). Finally, T4 recorded a final value of 0.032±0.05 kg.

Figure 3 illustrates the average weight gain and average milk consumption of all treatments. Both variables have a homogeneous behavior. They had an initial consumption of 0.348±0.127 kg on day 1. The values of this variable were then similar until day 13 (0.668±0.073 kg), when the peak of consumption was recorded. The two greatest drops in average consumption for the four treatments were recorded on day 51 (0.472±0.141 kg) and day 57 (0.478±0.083 kg). Likewise, the kid weight gain variable showed homogeneous values during the study, starting from an initial gain of 0.099±0.028 kg. The highest

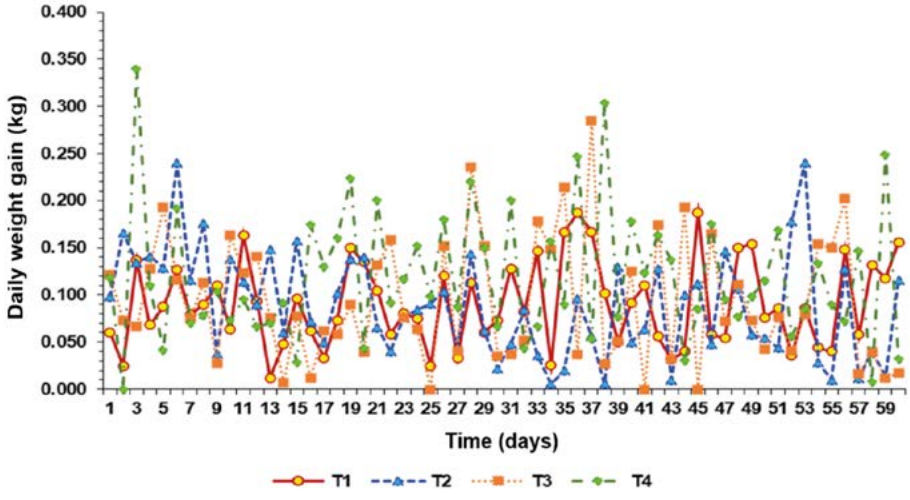

Figure 2. Average daily weight gain (kg) per treatment.

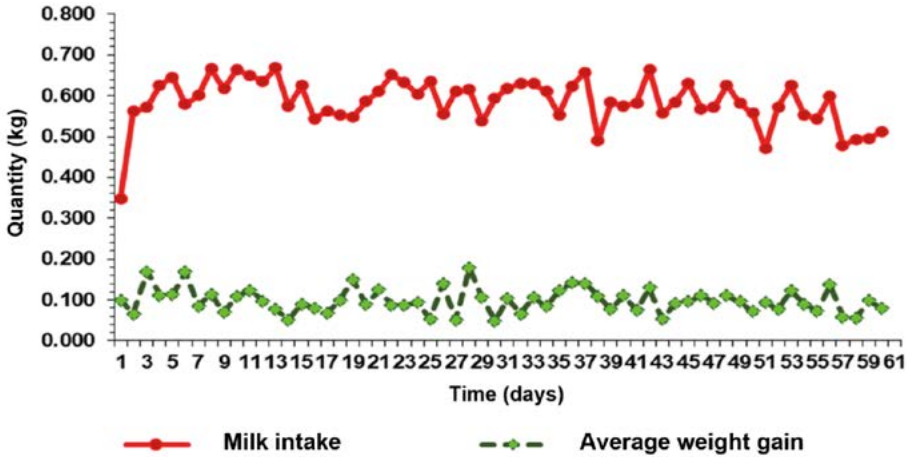

Figure 3. Average daily milk consumption and weight gain.

values were recorded on day 3 (0.169±0.118 kg), day 10 (0.109±0.049 kg), and day 19 (0.15±0.055 kg). The same behavior was reported during sampling, while similar low values were recorded on day 14 (0.052±0.035 kg), day 25 (0.054±0.049 kg), and day 58 (0.055±0.053 kg).

Figure 4 shows the results using a scatter diagram (n=17) prepared for the 4 treatments and its correlation (r=0.879) between the two daily weight gain and daily milk consumption variables. According to the analysis, these two variables have a linear and positive relationship, with a 0.103 slope and a 95% confidence interval (0.072 to 0.133), indicating that a 1.0 kg increase in milk consumption is expected to result in a 0.103 kg weight gain, when milk consumption ranges between 0.2 kg and 0.95 kg. Milk consumption accounted for approximately 77% (R^2=0.772) of the variability in weight gain.

Figure 5 illustrates the accumulated results for the weight gain (kg) variable in relation to milk consumption (kg) for each kid per treatment. On the one hand, T2-2-1 recorded

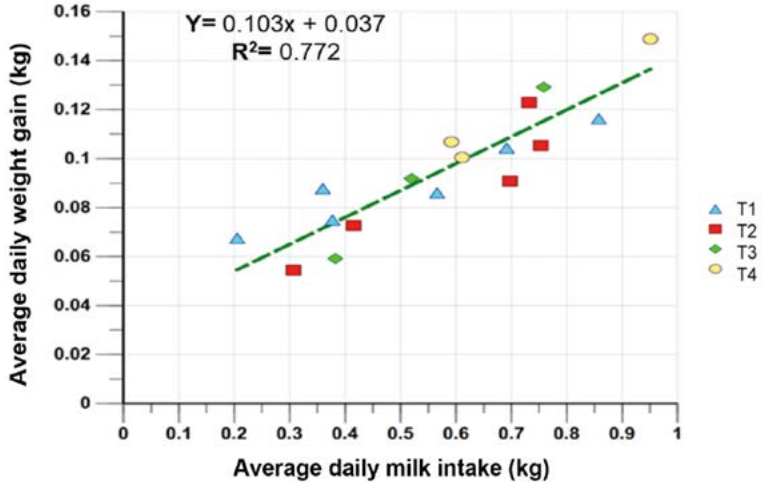

Figure 4. Scatter plot of the average weight gain and daily milk consumption, per kid (n=17), indicating the treatment to which it belongs.

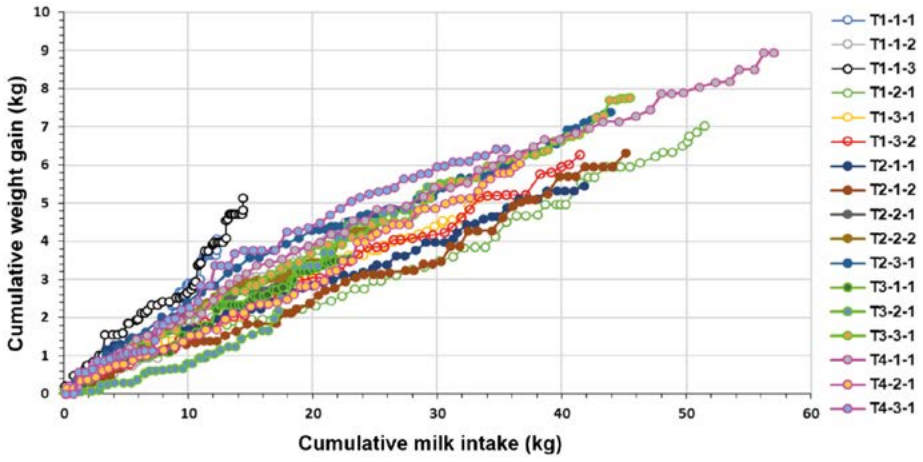

Figure 5. Accumulated weight gain (kg) and accumulated milk consumption (kg), for each kid in each treatment.

the lowest weight gain in the entire experiment (3.26±0.896 kg), with an accumulated consumption of 18.42±5.891 kg of milk and a feed conversion of 5.65±0.811 kg of milk consumption to gain 1 kg of weight during 60 days. On the other hand, T4-1-1 was the kid with the highest accumulated weight gain (8.935±2.603 kg) and the highest accumulated milk consumption (57.05±17.362 kg) during the experimental period. However, its feed conversion was higher than T1-1-3 —*i.e.*, it required a higher milk consumption to gain 1 kg of weight (conversion=6.385±0.636 kg).

No significant differences were found between treatments ($p>0.05$) for both variables (milk consumption and weight gain); however, certain behaviors which require further discussion can be perceived in the evolution of the two variables under study. The results match the findings of Galina *et al.* (2009), who supplemented the diet of kids with a lactic bacterium with probiotic benefits, recording an average daily weight gain of 0.169±0.018 and 0.129±0.022 kg/day in their treatment and in the control, respectively. These values are similar to those found in the evaluated treatments, especially in T1 (ASINC with ORE) and T3 (SINC without ORE). For their part, Williams *et al.* (2018) added dry oregano to the diet of growing kids and likewise found weight gains, both in the control treatment (0.146 kg/d) and in the tested treatments (0.126 kg/d and 122 kg/d), for which the doses of oregano in the diet were increased. The quantities evaluated in the said study were higher than in the present research, although the authors reported that the amount of oregano added did not significantly change food consumption and weight gain. As in the present study, these two authors used weaned kids. The results of this research do not differ from those observed by Avilés *et al.* (2019), who used the suckling-weighing-suckling method to measure the development of kids, using melatonin for the milk production of the mothers and obtaining average weight gains of 0.1-0.18 kg/d. These amounts are similar to those shown in Figure 3 for the total average weight gain. However, the said study reported statistical differences ($p<0.05$). Likewise, García and González *et al.* (2017) determined a positive correlation between milk consumption and weight gain among the kids in their study. A similar situation was observed in the present research.

CONCLUSIONS

In conclusion, including *Lippia palmeri* in the diet and the nutrient synchrony does not significantly impact the development and behavior of the kids under study. However, the results match the findings of other researchers about weight gain and milk consumption through the mothers, which resulted in normal growth values.

REFERENCES

Abbas, S., Rashid, M. A., Yousaf, M. S., Ashraf, S., Rabbani, I., Zaneb, H., S. K. Tahir, S. K., Shahzad, A. H. & Rehman, H. 2020. Effect of maternal yeast feeding on dam performance and serum health biomarkers of Beetal goat kids. *South African Journal of Animal Science, 50*(2), 281-290. http://dx.doi.org/10.4314/sajas.v50i2.11

Avilés, R., Delgadillo, J. A., Flores, J. A., Duarte, G., Vielma, J., Flores, M. J., Petrovski, K., Zarazaga, L. A. & Hernández, H. 2019. Melatonin administration during the dry period stimulates subsequent milk yield and weight gain of offspring in subtropical does kidding in summer. *Journal of Dairy Science, 102*(12), 11536-11543. https://doi.org/10.3168/jds.2019-16836

Benson, M. E., Henry, M. J. & Cardellino, R. A. 1999. Comparison of weigh-suckle-weigh and machine milking for measuring ewe milk production. *Journal of Animal Science, 77*(9), 2330-2335. https://doi.org/10.2527/1999.7792330x

Galina, M. A., Delgado-Pertiñez, M., Ortíz-Rubio, M. A., Pineda, L. J. & Puga, D. C. 2009. Cinética ruminal y crecimiento de cabritos suplementados con un probiótico de bacterias ácido-lácticas. *Pastos y Forrajes, 32*(4), 1-1. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=s0864-03942009000400009

García y González, E. G., Flores, J. A., Delgadillo, J. A., González-Quirino, T., Fernández, I. G., Terrazas, A., Vielma, J., Nandayapa, E., Mendieta, E. S., Loya-Carrera, J., Flores, M.J. & Hernández, H. 2017. Early nursing behaviour in ungulate mothers with hider offspring (*Capra hircus*): Correlations between milk yield and kid weight. *Small Ruminant Research*, 151, 59-65.

Gómez-Gómez, D. A., Pico-Gutiérrez, M. Y., Marín-Mejía, B. de J. & Álvarez-Ramírez, L. 2019. Efecto del consumo de leche fermentada con Bifidobacterium y *Lactobacillus casei* sobre ganancia de peso y duración de diarreas en cabritos lactantes. *Spei Domus, 13*(26-27), 1-8. https://doi.org/10.16925/2382-4247.2017.01.01

International Business Machines (IBM). 2013. IBM SPSS Statistics for Windows, Version 22.0. IBM Corp. Armonk, NY, USA. N/p.

Ramírez, R., Armenta, J. A., Ramírez, R. G. & Romero, E. 2011. Organic matter and crude protein ruminal degradation synchrony in diets selected by range goats. *Tropical and Subtropical Agroecosystems, 14*(1), 109-117. https://www.redalyc.org/articulo.oa?id=93915703009

Sinclair, L. A., Garnsworth, P. C., Newbold, J. R. & Buttery, P. J. 1993. Effect of synchronizing the rate of dietary energy and nitrogen release on rumen fermentation and microbial protein synthesis in sheep. *The Journal of Agricultural Science, 120*(2), 251-263. https://doi.org/10.1017/S002185960007430X

Troyo, E., Mercado, G., Cruz, A., Nieto, A., Valdez, R. D., García, J. L. & Murillo, B. 2014. Análisis de la sequía y desertificación mediante índices de aridez y estimación de la brecha hídrica en Baja California Sur, noroeste de México. *Investigaciones Geográficas, 85*, 66-81. http://dx.doi.org/10.14350/rig.32404

Williams, P., Cifuentes, X., Velasco, V., Campos, J., Bórquez, F., & Allende, R. 2018. Can dietary dried oregano improve the digestible nutrient intake of growing goats? *Chilean Journal of Agricultural & Animal Sciences, 34*(1), 19-25. https://scielo.conicyt.cl/scielo.php?pid=S0719-38902018000100019&script=sci_arttext&tlng=e