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Formation of MEVEZUG Pure Ovino Reproducers in Tierra Caliente Guerrero, Mexico

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Abstract: The objective of the present work was to obtain pure ovine reproducers. Starting 2010 work began with the sheep herd of the Faculty of Veterinary Medicine and Animal Science of the Universidad Autónoma de Guerrero, located in the municipality of Pungarabato, Guerrero State, México. The faculty is 250 meters above sea level. The climate of the region is warm subhumid, with average temperature between 24 and 30 °C, but in the heat season maximum temperatures up to 46° down in the shade. The rainfall regimen is 800-1,200 mm of rainfall per year. The production of sheep in Mexico is characterized mainly by creole animals and crosses are made with pure breeds imported from several European countries and USA. Therefore, there is a need to form local breeds adapted to the climatic conditions and production systems of Mexico. The sheep herd initially had 100 animal of hair, with 70 sheep with their lambs and a reproducer. These animals had phenotype Pelibuey, Black Belly, Doper and Katahdin. As of May 2010, consanguineous crosses were established. During this period the parameters were registered: date and type of birth, weight and sex of the newborn. Data on BW (Birth Weight) of males and females were analyzed by ANOVA (Analysis of Variance) and multiple comparison test was used for the comparison of means (Duncan, 1955), with a significance level of $P < 0.05$. The first reproducer was brown tobacco and had antlers, and the females had different phenotypes. Up to the present time, there are twenty studs with their respective descendants, and year 2019 the herd has 100 animals light brown and tobacco with their lambs (30), and a reproducer. The sheep are of medium size with 45 and 60 kg of average weight in females and male, respectively. Out of a total of 326 females and 335 males born, with an average weight of 2.62 kg at birth and a proliferative index of 1.41, 20 MEVEZUG males were selected to be used as reproducers in 20 herds distributed in different sheep production units of the state of Guerrero. From the crosses of these breeders to the females of these herds, F1 animals (MEVEZUG × Criollo) are obtained. The sheep of different color to light brown or tobacco are discarded for the supply; the males are fed for the fodder in native meadows with irrigation with 95.17 ± 19.45 g of daily gain of weight. In 2016, the trademark MEVEZUG was registered. It is concluded that to date the color of the breed has been fixed in females and males, which is light brown and tobacco brown, the registered productive indexes are acceptable and work will be continued to improve size and productive indexes, through selection of the best sheep.

Key words: MEVEZUG, pure, ovine, reproducers.

1. Introduction

In Mexico there are 7,306,600 heads of sheep, the genetic base is of Spanish origin, due to the sheep brought during the colony, later in the XIX, XX centuries and the passing of the XXI sheep of defined breeds was imported from European countries, South Africa and the United State of America (USA), with marginal efforts of formation of locals breeds, the foregoing is reflected in a genetic dependence. With data from the Secretary of Economy the import of standing sheep, with a high registration certificate in 2006 from Australia there was more than 18,000 livestock and in 2007 of 35,000, corresponding to New Zealand in 98.3% [1].

The breeds of sheep hair that entered the country in the nineties of the last century were the Dorper from South Africa and Katahdin from the USA, in 1977 pure Dorper stallions were imported from this country, before the importation of these breeds, the sheep of hair in the tropical regions in Mexico corresponded to

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the Pelibuey and Black Belly, later and in gradual form the absorption process becomes present, for this reason, at the present time—the sheep herds in the dry and humid tropic have crossings of the breeds Pelibuey, Black Belly, Dorper and Katahdin that is phenotypically reflected in a mixture of brown, black and white colors.

In Mexico, efforts to develop local breeds are practically absent, possibly in the vicinity of the USA, different situation in South American countries, in Brazil with the Santa Inés and Pantaneira, Colombia sheep moor Colombian [2-4]. Therefore the objective of the work was to obtain purebred sheep and the long-term formation of a breed.

2. Materials and Methods

The information of 661 BW (Birth Weight) records for, sheep, with delivery during the years from 2010 to 2019, located in the Faculty of Veterinary Medicine and Zootechnics N.1 in the Municipality of Altamirano, from Tierra Caliente region from the state of Guerrero, Mexico was used.

This region is located at 18°20'30" North and 100°39'18" West in an altitudinal range of 250 masl. The average temperature is 25 °C with average precipitation of 1,200 mm per year. Four seasons are defined. Spring corresponds to the months from March to May, summer from June to August, autumn from September to November and winter from December to February. There are two well marked seasons, one with rains (from June to November), with mean temperature of 18 °C and rainfall of 1,027 mm, and another dry season (from December to May), with average temperatures of 32 °C and 750 mm of precipitation [5, 6].

In 2002 the herd consisted of 25 sheep of the Pelibuey breed. The creation of the breed began in 2004 with a base herd of 50 crossbred females, Dorper, Pelibuey and Black Belly breeds. From there, several crossings were carried out with studs of different breeds (Dorper, Black Belly, Pelibuey and Kathadin), with four registration periods, during the years 2006-2007, 2008-2009 and 2009-2010 respectively. Animals with light brown or tobacco brown hair were selected, with BWs averaged at least 2.5 kg, which came from multiple births. Afterwards, inter se crosses were carried out. Feeding consisted basically on rotating grazing in five meadows, with native pastures of the region such as bermuda (*Cynodon dactylom*), Venezuelan grass (*Panicum fasciculatum*), spider three-awn (*Aristida ternipes*), smooth mesquite (*Prosopis laevigata*), cueramo (*Cordia elaeagnoides*), cubata (*Acacia cochlicantha*), pinzan (*Pithecellobium dulce*), huizache (*Acacia farneasiana*), cheeseweed (*Malva parviflora*), morning-glory (*Ipomoea purpure)*, zapotillo (*Cuphea aequipetala*), cassia (*Cassia didymobotrya*) and railroad creeper (*Ipomoea cairica*). These pastures were only irrigated during the dry season.

In 2017 feeding program was carried out, in the native grasslands described above, with 18 lambs resulting from the year 2009 cross of the Pelibuey-Black Belly × Dorper-Katadhin breeds, with an average weight of 21.9 ± 4.2 kg, which were grazed from 9 am to 7 pm for 84 days, with a previous period of getting used to 15 days and with weight record at the beginning of the work, then every 21 days. At the end of the random feeding period, 6 lambs were slaughtered for the determination of hot and empty carcass yield.

The percentage of chemical compositions in dry base of the grasslands was: 26.2, 13.4, 5.5, 10.4, 23.7, 48.6, 39.1, 63.7, 38.6, 22.6, 27.7 and 5.9 of dry matter, raw protein, ethereal extract, ash, raw fiber, nitrogen free extract, detergent acid fiber, neutral detergent fiber, cellular content, hemicellulose, cellulose and lignin respectively.

The lambs were identified by means of earring in the ear of each animal, they were weighed with a digital scale with a scale of 10 g with a previous fast of 12 hours in four periods, at the beginning of the work and later every 21 days during 84 days.

The variables studied were DWG (Daily Weight Gain), hot carcass yield with intestinal gastro tract content and empty without intestinal gastro tract content.

The reproduction was carried out by natural mating with controlled breeding, which consisted in separating the sheep from the stud, without having any visual, auditory and olfactory contact for a minimum period of one month. The stud stayed an average of 35 d, with the females suitable for reproduction (minimum weight of 25 kg at the first service). The sudden introduction of the males into the herd induces hormonal changes in the females, which leads to ovulation and estrus (male effect). This allowed us to concentrate parturition season in the same month, which guarantees a better care for the newborn and for mothers during and after parturition, as well as having lots of more lambs.

Lambs were left with the mothers in a tillering pen (sheep-lamb link), during the first three days of birth, to verify the consumption of colostrum, disinfection of the navel and place the identification earring. Later, and during the lactation period, they stayed with their mothers during the day (from 9 a.m. to 6 p.m.) during grazing, where they were given water ad libitum. At the afternoons, sheep, lambs and replacement females were locked in the same pen, where they were offered 100 g/animal/d of maize grain, only within the critical period of forage availability (in the months from February to June).

The collected data were subjected to ANOVA and the means were compared by the Tukey and Duncan test [7].

3. Results and Discussion

3.1 Sheep Color

Table 1 shows the evolution of the phenotypic characteristic of the color of the sheep's coat in the herd, with an increase of 198.4% from 2012 to 2019 of the brown color and with a statistically significant difference (P□0.006) between the average 73.6% of this and the colors black, black belly, black paint, Brown white and white spots and statistically similar between the percentages of these, without the presence of these colors in the years 2016 and 2019 with the exception of the brown white spots that appeared in the mentioned years.

The variation in the coat of the sheep in the herd in 2012, shown in Table 1, is possibly due to the different crosses of sheep with Pelibuey and Black Belly phenotypes and breeders with Dorper phenotypes from 2004 to 2005 in three; Black Belly one 2005, Dorper, in three 2008-2007; Black Belly three 2008-2009 and Pelibuey-Katahdin two 2009-2010 as reported by Mireles, et al. [8].

The above contrasts with the color of the sheep in 2019 with 92.6% brown, without the presence of black, black belly, black with white and white spots, can be attributed to the crossings of the sheep from 2009 to date with light brown or tobacco brown breeders, from the same herd and from 2016 the mark is registered with the INPI (National Institute of Industrial Protection) with the name MEVEZUG.

3.2 Discarded Sheep

Table 2 shows the number of discarded sheep of colors other than light brown or tobacco brown from 2011 to 2014. The discarded animals were black, black with white spots and black belly, later the black belly and brown with white spots were eliminated, corresponding to the year 2012 the highest percentage of discard followed by 2016; in the year 2019 the herd was constituted by sheep with light brown and tobacco brown coat.

In Table 2, it is observed that the waste animals were those of different color to light brown or tobacco brown with a total of 106 sheep, of which 25.5% corresponded to the year 2012, this can be attributed to the presence in the herd of a greater number of black females, black with white spots and black and black belly, in subsequent years the percentage of waste was less than 20% and in 2019 it was 9.4%, this can be related to the

Table 1 Number, percentage and average color of the sheep's coat in three years in the process of formation of the MEVEZUG breed.

Sheep color	2012	%	2016	%	2019	%	Average %
Brown	16	37.1	40	91	50	92.6	73.6[a]
Black	11	25.9	0	0	0	0	8.6[b]
Black belly	5	11.1	0	0	0	0	5.5[b]
Black and white p	6	14.8	0	0	0	0	4.9[b]
White brown	0	0	4	9	4	7.4	3.7[b]
White	5	11.1	0	0	0	0	3.7[b]
Total	42	100	44	100	54	100	P 0.006

p = White patches, averages with different literal in column are statistically different (P 0.05).

Table 2 Number and percentage of discarded sheep of different coat than light brown and tobacco brown in five years of selection.

Year	Discard Number	%
2011	11	13.6
2012	27	33.3
2013	4	4.9
2014	20	24.7
2016	19	23.5
Total	81	100.0

presence of greater number of light brown sheep or tobacco by crossing whit breeders of this color.

3.3 Color of Lambs

In Table 3, we can see that 7.9% of the lambs at birth are black or white with white and black spots, with no statistical difference between them, however with (P 0.0001) when comparing brown 78.7% and 14.24% respectively. In the same table it is observed that the brown color exceeds a maximum of 90% and a minimum of 60%, compared to a maximum average of 14.15% and a minimum of 0% in the other colors.

The effect of crossing the 2010 sheep with the phenotype of four breeds with brown breeders from the same herd and the formation of pure sheep, is observed in the higher percentage presence of brown lambs as shown in Table 3, with a maximum of 92.8% in 2019 and a minimum in lambs born in the first birth with 60.7%, this can be attributed to the phenotypic contribution of brown color in 50% of the breeders and the other half to the sheep whose coat colors were diverse. This maximum value is possibly reflection of the increase in the population of brown sheep during the period 2010-2019.

3.4 Reproducers

Of the lambs born from 2010 to 2019, 30 breeders have been selected and until 2020 there are 20 MEVEZUG breeders that meet the characteristics of light brown or tobacco brown color and are located in the equal number of herds in the region of Tierra Caliente of the states of Michoacán, state of Mexico and Guerrero.

3.5 Weight of Lambs and Type of Delivery

In Table 4, it is observed that there is a difference of 90 g between the BW of males compared to females, this amount only represents 3.4%, therefore statistically the weights at birth of males and females are similar (P 0.3141), at another point there have to be 9 more males than females, which translated in 50.7% and 49.3% respectively. As a novelty it is observed in Table 4 that the average weights of females and males at birth are statistically similar (P 0.3141), probably as a result of the decrease in weight at the birth of males before 2010

Table 3 Number and percentage of lambs born from 2010 to 2019 of purebred MEVEZUG animals formed by the 2010 cross of Pelibuey, Black Belly, Dorper and Kathadin sheep.

Color	Number of lambs	Porcentaje	Maximum	Minimum
Brown	519	78.47[a]	92.8	60.7
Black belly	94	14.24[b]	32.1	0
Black or brown m	27	4.03[c]	9.7	0
White	21	3.13[c]	14.7	0
Black	1	0.13[c]	0.13	0
Total	661	P□0.0001	-	-

m = White spots, averages with different literal are statistically different (P□0.05).

Table 4 Number and weight of males and females (kg) of lambs MEVEZUG in Cd. Altamirano, Guerrero-Mexico.

	Males		Females		
Breed	Numbers	B. Weights	Numbers	B. Weights	P
MEVEZUG	335	2.65 ± 0.66	326	2.56 ± 0.63	0.3141

B. = Birth, Numbers in same row different literals are statistically different (P< 0.05).

in relation to those born later, a situation that was not observed in females, in the former it decreased by 310 g and in the latter 80 g [9].

This does not occur in the data of Macedo and Arredondo [10], who recorded the weights of males with 2.82 kg and in females 2.60 kg (P□0.05) in Pelibuey sheep in intensive system. Castellaro et al. [11], determined in Merino precoz, Suffolk and crossbred lambs of 4.78 kg and 4.60 kg in males and females respectively by difference (P≤ 0.05). Forero, et al. [12] reported a BW of 4.83 kg in males and 4.33 kg in females (P□0.0005) in crosses of Merino sheep with Merino Precoz and Ile France in intensive system. Brzozowska et al. [13] in a study of Pomeranian sheep in organic farm reported BW of 5.4 kg and 5.1 kg (P□0.05) in single birth and in double birth and 4.1 kg and 3.8 kg (P□0.05) in males and females respectively.

With the figures in Table 5 it is derived that there were a total of 467 births, of these 282 were single, 176 doubles and 9 triple which meant 60.4%, 37.7% and 1.9% respectively. In relation the weight at birth single lambs birth weighed 19.8% more than delivery in double birth and 33.9% in relation to triple, without quadruple births. With regard to the type of birth, the weights of the single, double and triple lambs presented difference (P□0.0001) between them.

With the figures in Table 5 it was determined that there were 467 births and 661 lambs with an average weight of 2.62 ± 0.64 kg, this translated into a prolificity index of 1.44 which is lower than the one reported by Mireles, et al. [8], with 1.56, this may be due to the effect of interse crossings. BW is strongly influenced by the type of birth, as reported by various authors [14-16]. However, the difference in weight between lambs in single birth and those in triple birth is very wide, as shown in the figures in Table 5, and less in relation to double birth with 33.9% and 19.8% respectively reported by Mireles, et al. [9], with 3.23 kg, 2.69 kg and 2.13 kg in single, double, and triple births, this can possibly be attributed to the fact that in the present work they are pure animals and from the mentioned study, of crossing sheep of four different breeds.

Macedo and Arredondo [10] , in Pelibuey sheep in intensive system reported weights of 3.64 kg, 3.00 kg, 2.50 kg and 2.06 kg in single, double, triple and quadruple births respectively, values higher than those of this work, this may be due to the supplementation with 250 g of concentrate during late gestation stage in which there is greater fetal growth [17].

Table 5 Number and weight of lambs MEVEZUG at birth (kg) according to type delivery in Cd. Altamirano, Guerrero-Mexico.

Breed	N	Single	N	Double	N	Triple	P
MEVEZUG	282	2.98 ± 0.64^{a}	352	2.39 ± 0.47^{b}	27	1.97 ± 0.53^{c}	< 0.0001

N = Number. Numbers in the same row to type of delivery, with different literals are statistically different (P< 0.05).

Table 6 Initial and final live weight (kg) and DWG (g) of MEVEZUG lambs in native grass-lands.

Identification	initial LW kg	Final LW kg	DWG g
1	24.19	30.52	75.4
2	21	30.1	108.3
3	27.8	36.58	104.5
4	23.72	32.64	106.2
5	30.02	41	130.7
6	24.76	33.64	105.7
7	23.01	31.18	97.3
8	27.56	35.02	88.8
9	22.97	32.28	110.8
10	20.2	29.34	108.8
11	20.47	26.44	71.1
12	21.9	27.96	72.1
13	19.78	29.62	117.1
14	22.6	29.62	83.6
15	14.33	21.83	89.3
16	17.14	25.44	98.8
17	16.53	20.74	50.1
18	16.28	24.2	94.3
Average	21.90	29.90	95.17
SD	4.22	5.09	19.45
CV	19.27	17.03	20.44

LW: live weight, DWG: daily weight gain, SD: standard deviation, CV: coefficient of variability.

3.6 DWG and Carcass Yield

The maximum DWG was 130.7 g and minimum of 50.1 g which represented 37.33% and 47.36% above and below the average respectively, where 44.44% of the lambs DWG was greater than 100 g and 55.56% below this figure, however the coefficient of variability was less than 20% (Table 6).

The DWG corresponds to lambs under a grazing diet, that is to say a 100% forage diet, however, the 95.17 g (Table 6) was higher than the one reported by Ortiz, et al. [18], in lambs grazing in native grasslands of *Bothriochloa pertusa* supplemented with nutritional blocks and Fernandez, et al. [19], when supplementing with 6 g kg^{-1} of live weight of molasses where they reached 71 g and 77 g DWG, respectively. Likewise, Getu, et al. [20], in a work with lambs in *Andropogon*, *Penisetum* and clover species prairies reached values of 75.3 g DWG. These values can possibly be attributed to the reduced variety of forage species when compared to the 16 forage species of the grassland of this study.

For their part, Ekiz, et al. [21] indicated DWG of 87.15 g in lambs that grazed for 96 days in temperate climate grasslands, with a composition of 52% of grasses (*Festuca* spp. *and Lolium* spp.); 22% of legumes (*Trifolium* spp., *Medicago* spp. and *Vicia* spp.) and 26% of other families.

Table 7 Live weight, carcass, hot and cold carcass yield of MEVEZUG lambs fed in native pasture.

Identification	LV (kg)	Carcass (kg)	HCYWIGC %	HCYWhIGC %
1	31.18	12.42	39.8	48.91
2	27.56	10.32	37.4	47.75
3	25.46	9.43	37.0	48.38
4	20.74	7.62	36.7	48.90
5	34.84	13.52	38.8	50.80
6	23.24	9.03	38.9	49.55
Average	27.17	10.39	38.12	49.05
DS	5.19	2.21	1.22	0.96
CV	19.11	21.25	21.25	1.95

LV = Live weight, HCYWIGC = Hot carcass yield with intestinal gastro content, HCYWhIGC = Hot carcass yield without intestinal gastro content.

Dickhoefer, et al. [22], reported DWG of 98 g with light grazing and 62 g when grazing was intensive, in sheep grazing in native grasslands in semi-arid climate in the steppes of Mongolian, in the interior of China. Ma, et al. [23] determined of 83 and 99 g DWG in sheep grazing in native grasslands in semi-arid climate in China in late spring and autumn, respectively. These DWGs are within the range obtained in the present study; this may be due to the fact that they were developed in native grasslands as well as those of the present study.

The DWGs close to those obtained in this work are reported by Frías [24], with Pelibuey × Katahdin, Dorper lambs handled in grazing of *C. plectostachyus* for six hours and with a consumption of 600 g·animal·d^{-1} of SACCHARINA (fermented sugar cane), to which 5% of VITAFERT was added in its formulation, 85 g of GDP. However, the author himself [24] with animals of the same breed and fed with *Pennisetum* cv Cuba CT-115 (4 kg), (537.5 g) SACCHARINA and a commercial food (100 g) achieved 109 g, values close to those in the present study, this can be attributed to the additional nutrient intake from the supplements.

In Table 7, it is observed that the yield in carcass was a maximum 39.8% and minimum 36.7% which represented 4.41% and 3.72% higher and lower in relation to the average, however 50% of the values were higher than 38% and the other half lower than this value, however the variability coefficient was above 21, this value was much higher than that derived from the yield in empty carcass performance with 1.95%. The carcass yield corresponds to lambs with 100% forage feeding with 38.12% (Table 7), similar to what is reported by Mireles, et al. [25], with 37.09% and 40.51% in native grasslands in the less rainy and rainy periods respectively in lambs of origin of the same herd of the lambs in this work, these values coincide with those reported by Ekiz, et al. [21], in a study with Kivircik lambs, fed on wheat stubble and native grasslands.

4. Conclusions

During the 10 years elapsed of the MEVEZUG sheep breed formation process, by means of interbreeding, the reproductive and breeding sheep ewes are light brown and tobacco brown, the BWs of males and females were statistically similar, the BWs of single, double and triple birth lambs were statistically different, DWG, hot carcass yield with intestinal gastro tract content and empty without intestinal gastro tract content were acceptable and similar to those reported in the literature for lambs in native grasslands.

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