Abstract—The aim of this study was to evaluate the effect of a Prolonged Melengestrol Acetate (MGA) treatment in pre-pubertal goats on the induction of ovarian activity, induction and synchronization of estrus and pregnancy rate. 10 pre-pubertal Saanen goats, 9 months of age, body condition of 2.1±0.32 (scale 1-5), a live weight of 30.44±1.93kg and size of 62.1±2.69cm were used. The treatment consisted on the administration of 0.22mg/goat/day of MGA orally, during 46 days. During the treatment, the ovaries were evaluated by rectal ultrasonography using a 7MHz transducer on days 15, 30 and 45 to observe the presence or absence of follicles. Once the treatment was completed, the sire was placed in the pen with the goats and estruses were detected during 10 days post-treatment. The pregnancy diagnosis was performed 45 days after breeding via transabdominal ultrasound using a 3.5 and 5MHz transducer. Since the first evaluation of ovarian activity, the 10 goats showed follicle development; in the right ovary an average of 9.66±4mm and 9.33±4mm was observed and in the left ovary 11.33<4mm and 9.66±4mm, without the presence of corpus luteum. 100% of the goats presented estrus and the pregnancy rate was 90%; concluding that the use of MGA at a dose of 0.22mg/goat/day in pre-pubertal goats during prolonged treatment induces follicular development, estrus synchronization and a high percentage of fertility by natural mating is obtained.

Index Terms—pre-pubertal goats, melengestrol acetate, follicles, estrus, pregnancy, echography

I. INTRODUCTION

In México, goat production takes place in rural areas (84% in ejido farming systems) with great advantages for its rusticity and use of available resources [1]. The production system is characterized by a single corral where the entire herd is together without differentiating physiological ages and stages, sustaining feeding mainly on corn stover; grazing on rangelands, hills and roadside, while feed supplementation in this system is scarce or absent [2]. Productive and reproductive rates are influenced by several factors, including: free mating (the male stays all year with goats) and no application of control techniques of ovarian activity [3]; hence, the need for proper reproductive management that achieves an increase in productivity and to enable the development of this sector, since the goats are an important economic livelihood of farm families in rural areas in México [1].

One of the factors influencing the efficiency of these production systems is the beginning of the reproductive activity of female goats. The age wing puberty, it has a huge impact on efficiency productive, reproductive and economic in goats by influencing the number of pups per female along its life time [4]. Puberty is defined as the manifestation of reproductive capacity, expressed in the animal’s ability to ovulate an oocyte capable of being fertilized, accompanied by the expression of estrus and the later development and maintenance of a corpus luteum of length normal. Puberty is characterized by the development of the axis reproductive (hypothalamic-pituitary-ovarian) and the metabolism general of the animal. These changes happen gradually they are associated with variables production as are body weight, the amount of adipose tissue expressed in body condition, genetics of the animal and modifications endocrinological in the axis hypothalamic-pituitary-ovarian [5].

Puberty starts when they reach 60-75% of their mature body weight, as long as it is in a favorable breeding season. If the time of puberty coincides with the period of stationary anestrus, this start will be delayed until the next breeding season, with negative repercussions on the productivity of animals [6].

Goats are in a biological possibility to start their ovarian activity accompanied with the first estrus at 27 weeks of age with a body weight of 22.2kg [7]. However some researches reported that goats in mexican subtropics born in January and May begin their ovarian activity in September and December of the same year of his birth with an average live weight of 27kg [8], this indicates a pronounced effect of seasonality due the month of birth on the initiation of ovarian activity, but if it this is postponed by is extended to 18 to 20 months of age. Also if one considers that feeding goats in rural areas of Mexico it is based primarily on grazing and agricultural wastes, which is reflected in their body condition expressed in a pronounced start of the ovarian activity [2].

The shift from a prepubertal state to one pubertal considers marked changes in the function of axis hypothalamic-pituitary-gonadal. Before puberty, the
secretion of Gonadotropin Releasing Hormone (GnRH) is inactive. To the onset of puberty, the release of GnRH is activated, the levels of the gonadotropic hormones Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH) are gradually increased by stimulating the development and maturation of follicles well as estrogen production in the ovaries [9], [10].

Before puberty, the system for feedback negative of steroids ovarian is particularly active, however, according advances stage pubertal the signal feedback positive of the steroids and highly efficient, observed, usually the establishment of an ovarian activity normal at the end of said step [11], [12]. The progesterone endogenous or exogenous plays a role in determining the capacity steroidogenic of follicles developing, by increasing production of estrogen of which participate in the development follicular end and ovulation [13]-[15].

The implementation of technical intensification of reproductive management, the use of hormonal protocols for reproductive control can offer advantages such as; shorten the reproductive seasonality, increase the productive life of the animal, improve fertility, group deliveries getting homogeneous lots of kids [16].

Progestogens constitute a group of hormones through which you can manipulate the estrous cycle of the goat, within this group Melengestrol Acetate (MGA) is located, is a synthetic progestational oral steroid used as a growth promoter [17] and to induce and synchronize estrus and ovulation [18]-[20] for their ability to inhibit estrus conduct, plus it is an extremely efficient, convenient and inexpensive method, ideal for rural goat production systems that will improve their reproductive and productive rates.

The purpose of any production system focused on the production of food is to use to animals destined for breeding as soon as possible, for the purpose of accelerate the onset of puberty and increase its life by reducing their production costs. In heifers a administration of progestins synthetic during the period pre-pubertal induced puberty [21], [22], in lambs are prepubertal administering a dose of 0.25 mg of MGA for 12 days, induction and accelerated development follicular up to phase pre-ovulatory, presenting puberty at 9 months of age [23]. In small ruminants is suggested than under practical conditions the administration of synthetic progestins like the MGA must be at 7 months or more of age and when the animals reach 60% of their adult weight for get a shortening the reproductive seasonality, increase the productive life of the animal, improve fertility, group deliveries getting homogeneous lots of kids [16].

Therefore, the aim of this study was to evaluate the effect of a prolonged treatment (46 days) with Melengestrol Acetate (MGA) in pre-pubertal goats on the induction of ovarian activity, induction and synchronization of estrus and pregnancy rate.

II. MATERIAL AND METHODS

10 pre-pubertal Saanen goats 9 months of age, body condition of 2.1±0.32 (scale 1-5), live weight of 30.4±1.93kg, height of 2.69±62.1cm were used. The goats were dewormed and vitaminized one month before the start of the experiment. The treatment consisted on the administration of 0.22mg/goat/day of MGA orally, for 46 days. All goats received the same management and were fed with a calculated diet based on a concentrate, ground corn stover, molasses and oil (DM 90.90%, EE 3.43%, CF 24.04%, CP 16.84%, ashes 5.73% y NFE 49.95%).

Before treatment an evaluation of ovarian activity was performed rectally using an Ultrasound in mode B (Draminski, profi animal model) equipped with a 7MHz sector scanner transducer to determine whether goats presented or not follicular structures. During treatment ovarian activity was evaluated on days 15, 30 and 45 for the presence or absence of follicles.

Once the treatment was concluded the sire was introduced into the corral with the goats and estrus was detected during 10 days post-treatment. The gestation diagnosis was performed 45 days after breeding by transabdominal ultrasound using a transducer with 3.5 and 5MHz. Data was analyzed using descriptive statistics techniques.

III. RESULTS

During treatment, weight, height and body condition of goats was increased up to 38.1±3.48kg, 67.3cm and 3.1±0.21 BC respectively at 10 months of age. In the days of ovarian activity evaluation the 10 goats presented follicle development: in the right ovary was observed an average of 9.66≤4mm and 9.32≥4mm and in left ovary 11.33≥4mm and 9.66≥4mm, without the presence of corpus luteum (Table I).

| TABLE I. NUMBER OF FOLLICLES AND CORPUS LUTEUM DURING TREATMENT WITH MGA |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Day             | Right Ovary     | Left Ovary      |                    | Right Ovary     | Left Ovary      |                    |
|                 | Follicle <4mm   | Corpus luteum   | Follicle ≥4mm     | Follicle <4mm   | Corpus luteum   | Follicle ≥4mm     |
| 15              | 10              | 7               | 12                | 8               | 9               | 8                |
| 30              | 11              | 12              | 14                | 12              | 12              | 12                |
| 45              | 12              | 12              | 12                | 12              | 12              | 12                |

Figure 1. Distribution of presentation of estrus by oral post-treatment with MGA

The 10 goats presented estrus within a period of 5 days (from day 3 to 7 post-treatment). The presence of estrus was greater on days 4 and 5 (Fig. 1).

The percentage of goats in gestation was 90%.

IV. DISCUSSION

Despite the nutritional content of the diet during the treatment, the goats did not reach the ideal first serve size:
During treatment with MGA follicles of different sizes were observed, similar results were observed [23] in pre-pubertal ewes, who to the administer a dose of 0.25 mg of MGA for 12 days, observed that MGA induces and accelerates development follicular up to the phase pre-ovulatory, presenting puberty at 9 months of age. The results in both studies can it be explained due to the administration of synthetic progestins like the MGA plays a role in determining the capacity steroidogenic of follicles developing, by increasing production of estrogen of which participate in the development follicular end and ovulation.

During treatment none of the goats ovulated, indicating that the dose of 0.22mg/goat/day of MGA administered over a prolonged treatment was sufficient to suppress ovulation, and corpus luteum was not observed during the treatment. Previous researches indicates that an appropriate dose of the progestogen reduces the release of Releasing Hormone Gonadotropin (GnRH), which in turn decreases the production of Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH), but does not suppress it, so follicular development is presented until it reaches a dominant follicle [27]; this follicle does not ovulate because of the lack of the preovulatory LH peak, but does not suppress FSH secretion, which explains the development of follicles [28].

The same study reported that the dose 0.22mg/ewe/day of MGA during prolonged treatment, suppresses ovulation without affecting follicular dynamics, allowing normal follicular development in waves [27]. The results obtained in this study with the same dose (0.22mg/animal/day) was able to induce ovarian follicular development and maintained it in pre-pubertal goats 15 days after treatment initiation, suppressing ovulation during the 46 days of treatment with MGA.

After treatment with MGA concluded and before the goats were 11 months age, 100% of them expressed estrus in a short period of 5 days from day 3 post-treatment. This must to the discontinue treatment with MGA it is eliminated the blocking of peak GnRH and therefore the peak of LH what triggers the process hormonal characteristics of the cycle estrous, allowing he development follicular up to stage final (follicle pre-ovulatory) and ovulation [27].

These results are similar to those obtained by other researchers [29] who used 37 ewes in an equal dose of MGA, where they found estrus percentage of 90%, which makes evident that the dose efficiency of 0.22mg per animal for induction and synchronization of estrus. Meanwhile, some authors [30] used a similar dose of MGA to that of this study (0.25mg/goat/day) for 10 days in 22 goats and found that 84% of the goats presented estrus.

To evaluate the effect of MGA on the induction of estrus in ewes in an anestric stage, used a dose of 0.45mg of MGA/ewe/day orally for 17 days, observed that 100% of MGA treatment ewes presented estrus, which makes evident that the administration of MGA during prolonged [31] treatment as administered in this study is effective in inducing and synchronizing estrus.

Some researches report that when using a dose of 0.22mg of MGA in combination with an intramuscular injection of 300 IU of Pregnant Mare Serum Gonadotrophin (PMSG) for nine days, 100% of the animals presented estrus [32].

In a different research which used a low dose of 0.125mg MGA for 9 days, observed in 286 ewes that the response to the presentation of estrus was 62%, and when the same dose was administered for 12 days in 130 ewes observed that the response to the presentation of estrus was 89% [19]. This indicates that the response to the presentation of estrus is associated with the duration of the treatment.

The response obtained in goats to the treatment with MGA to induce follicular development and synchronize estrus in pre-pubertal goats under a traditional management in rural areas in México was acceptable, before the goats reached the age of 11 months were served by the sire. Commonly in rural areas in México, the goats get to have a healthy weight for their first service at a late age (18-20 months), because their feed is based mainly in corn stover; well as grazing on rangeland, disassembled mountains and roadside, for at that nutritional supplementation in this sector is scarce or absent, therefore impacts on that animals do not reach the proper weight and size [1], [8] and therefore delays the start of activity ovarian (puberty).

The high pregnancy rate (90%) was higher than that reported by other authors [31] who obtained a pregnancy rate of 70% in hair sheep, which were administered a dose of 0.45mg MGA during a prolonged treatment (17 days), using a dose of 0.5mg MGA for 10 days in goats a fertility rate of 74% was achieved [33], and with a dose of 0.4mg of MGA for 12 days a fertility rate of 45% was obtained [34]. For its part [17], in ewes to the administering a dose of 0.125 mg of MGA during 12 days, they obtained a rate fertility of 41%. These results may be due to peripheral levels of progesterone is it endogenous or exogenous regulating the patterns of growth follicular through of the feedback negative towards pulsatile secretion of LH [35]. When are administered doses high of MGA the suppression of LH it can be so intense that decreases their concentration and it has an effect negative in recruitment and development follicular; when are administered doses low, it is generated an increase in the frequency of pulses of LH which increase your concentration and triggers the development of follicles persistent [36]-[38], in both cases it is affects directly the rate fertility.

In a study in goats [30], at administer a dose of MGA similar (0.25mg) to this work during 10 days; they obtained a pregnancy rate of 58%. This result may be due to treatment duration was for a short period compared with of this research work it was during a long period, since in animals that are found with activity ovarian, the
administration of progestogen synthetic s like the MGA it
must be greater or equal to the average life of the corpus
luteum (goats of 17 days) to permit occurs lysis of the
corpus luteum naturally independently at the stage of the
estrus cycle on which this takes place, since if the
animal is found in follicular phase at initiation of
estrous cycle on which this takes place, since if the
corpus luteum naturally independently at the stage of the
luteum (goats of 17 days) to permit occurs lysis of the
must be greater or equal to the average life of the corpus
luteum as it was observed in this study [39].

Hence, the dose of MGA used in this study it proved to
be efficient for inducing development follicular for hi s
animal is found in follicular phase at initiation of
estrous cycle on which this takes place, since if the
corpus luteum suffers luteolysis at the time
that corresponds naturally without being affected by the
treatment and finally if the animal is found in anestrous
or at the stage pre-pubertal is induced activity ovarian
(development follicular) as it was observed in this study
[39].

V. CONCLUSION

It’s concluded that the use of MGA at a dose of 0.22mg/animal/day in pre-pubertal goats during a
prolonged treatment of 46 days, induces follicular
development, estrus synchronization and a high
percentage of fertility by natural mating is obtained,
which represents a viable alternative for the development
of goat raising in rural areas of México, since this activity
is still a very important economic livelihood of farming
families.

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