Mating Technique and Its Effect on Productive and Reproductive Traits in Rabbits

A. M. Heba-T-Allah[1,2], M. M. Osman[1], A. I. Elsheikh[3], and G. H. Chen[2]
[1]Animal Wealth Department, Suez Canal University, Ismailia, Egypt
[2]Animal Science and Technology College, Yangzhou University, Yangzhou, China
[3]Alexandria University Faculty of Vetrinary Medecine, Alexandria, Egypt
Email: {hebaabdelmoniem518, mohamedmansour965, elsheik1961}@yahoo.com, ghchen@yzu.edu.cn

***Abstract*—This study was conducted on two rabbit breeds new Zealand white (twenty does and four bucks) and hyplus (twenty does and four bucks). The aim was to study the effect of mating technique (natural mating and artificial insemination) on the Productive and reproductive traits of these two breeds. Parameters to be measured were Number of Service / Conception (NSC), Gestation Period (GT), Litter Size at Birth (LSB), 21 days (LS21days), weaning (LSW) and at marketing (LSM), Pre-Weaning Mortalities (PWM), litter weight at 21days (LW21days), weaning (LWW) and at the marketing age (LWM), Average Daily Weight gain (ADW) in both from 21 days old until weaning and from weaning until marketing age. Some parameters recorded a high significant difference between the two breeding method as NSC, LSB, S21days and LWM. While a non-significant difference was recorded within other parameters as GT, LWB, PWM.**

***Index Terms*—artificial insemination, rabbit, productive traits, reproductive traits, New Zealand white**

I. Introduction

In the past ten years, rabbit activities were rapidly expanded in Egypt. The Rabbits compared to other livestock animals are characterized by early sexual maturity, high prolificacy, relatively short gestation period, short gestation interval, rapid growth, more efficient feed conversion and low rearing cost [1]. Rabbit meat is nearly white, finely grained, palatable, mild flavored, low cholesterol content, high-quality protein content, and contains a high percentage of minerals than other meat types. Therefore, rabbit production might play a considerable role in solving the problem of meat shortage in Egypt [2]. This study was conducted to Study the effect upon the use of AI technique as compared with natural mating on the productive and reproductive traits of rabbits and the possibility of using artificial insemination as a substitute for natural mating. New Zealand white rabbit breed were inseminated by 0.5ml of fresh diluted semen containing 30×10^6 spermatozoa following subcutaneously injection with 50 IU HCG to induce ovulation the Conception rate was 52.4 vs. 65.2; gestation period averaged 31.7 vs. 3 1.2 days; litter size at birth was 5.8 vs. 7.8 and litter weight (g) / doe at birth was 383.7 vs. 477.5 for AI vs. natural mating respectively [3]. Later New Zealand white rabbit breed were injected with 0.2ml GnRH (Receptal) /doe at the time of insemination; the overall averages of conception rate, gestation length and litter size were 78.1%, 30.8 and 7.6; respectively. Compared to 72.73%, 31.00 and 5.38 for natural mating; respectively; with no significant differences during the gestation period between New Zealand white and Californian breeds [4]. Hyla nulliparous rabbits were injected 10 μg synthetic GnRH (Fertagyl, intervet) / doe IM; their results were 68.9% and 77.3% conception rate, 8.3 and 8.9 litter size, 64 and 63g bunny weight for Al and natural mating; respectively [5]. Fresh Hybrid Medium does indicated that the injection of 0.2ml of GnRH/doe and insemination with fresh diluted semen resulted 78.5% conception rate as compared to 81.4% in natural mating [6]. The average litter weight at birth was 303.7g and 287.1g in New Zealand white and Californian breed respectively; the average litter size at birth was 4.7 for both breeds with no significant differences between both breeds and the usage of Diluent with egg yolk tris resulted in the average litter weight at birth of 269.89 in both New Zealand white and Californian breeds [7]. reproductive performance of eight rabbits breed was compared and there were found a high significant difference between chinchilla breed and Himalayan breed Average total litter weight at birth was 429 and 357 respectively and at weaning was 3508 and 3209 respectively [8]. A study was conducted to measure litter size at birth, 21st and at weaning for giant Flanders (6.4±0.18, 5.17±0.2 and 5.18±0.21), New Zealand white (7.05±0.34, 5.91±0.37 and 5.7±0.39), Baladi red (6.77±0.21, 5.93±0.23, and 5.74±0.25) and v-line (7.36±0.26, 6.25±0.27, 4.99±0.29 and 4.55±0.3) and that their litter weight at birth, 21 day and at weaning of Flanders (347.32±8.85, 1314.31±38 and 1805.7±54.69g), New Zealand white (398.24±18.41, 1492.91±79.03, and 2141.11±114.14g), Baladi red (368.29±10.97, 1457.91±47.1, and 2026.2±67.79g), and V-line (417.67±16.87, 1359.65±72.43, and 1867.4±104.24g) [9]. New Zealand white Litter bunny weight at 21 days was 320±38g [10]. does performance in two different farms with natural mating or artificial insemination was investigated and reported that in natural mating litter size at birth was 9.0±0.3 while in artificial insemination litter

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size at birth was 8.4±0.3 [11]. A non-significant difference in gestation period 31.95±0.05 and 31.85±0.05, pre-weaning mortality % 33.33±1.28 and 33.29±1.34, litter weight at 21 days 14 73.1±31.0 and 1424.2±30.8, weaning weight 2898.1±64.4 and 2799.5±63.3 and in daily weight gain 0-21 day (g/day) 11.14±4.68 and 21.45±4.57 between New Zealand white breed and Californian breed respectively [12]. Pre-weaning mortality percent of New Zealand white rabbit was 20.8% and that litter weight at 21 days of New Zealand white rabbit was 1748g and weaning weight of New Zealand white rabbit was 3780g [13]. A significant difference in average litter weight at 21 days between New Zealand white 308g. and Hyplus rabbit 361g. and a non-significant difference in average litter weight at weaning between New Zealand white 523g. and Hyplus rabbit 532g; and with average daily weight gain (g/day) measured each ten days from weaning date (30 days old) till marketing (90 days old) for both New Zealand white breed and Hyplus breed reported them to be (54.95, 42.61, 33.66, 29.26, 27.54 and 25.10) and (55.56, 50.05, 41.87, 37.01, 31.17 and 28.21) with a significant difference between both breed [14].

The effect of injecting Buserelin 5mg in Hyplus rabbits breed was studied and reported that the pregnancy rate was 78.7% and the litter number at birth 10.3±0.12 [15]. Rabbits were induced to ovulate with an injection of five mg (0.5ml) of Buserelin I.m (Receptal, intervet, Salamanca, Spain) immediately before A.I I.M ovulation is estimated to occur 1-12h after GnRH administration [16]. Hyplus rabbit breed were weighted every week from 42 to 84 days old and reported average daily gain to be ranged from 38.84-29.43g/day [17]. Average daily gain of New Zealand white rabbit was 18.38 at 6-8 weeks age and 23.65 at 8-10 weeks age [18]. A non-significant difference during the gestation period between New Zealand white (31.58±0.17), Rex (31.95±0.19) and Flander (31.54±0.18);while reporting a significant difference in higher weaning weight of New Zealand white (669.50g) and Gabali breed (651.7g) compared to Californian (598.61g) and V-Line (440.50g); concerning average daily gain g/day he reported that Gabali rabbit was significantly (40.89) than V line (38.32), New Zealand white (34.46) and Californian (26.66g) at 4-6 weeks of age while at 6-8 weeks age Californian rabbit was a significantly higher average daily gain (52.53) than V line (28.60), New Zealand white (33.96) and Gabali (30.00) and at 8-10 weeks of age, there were no significant different between the four breeds (23.60, 20.85, 24.50 and 25.31) for New Zealand white, Californian, V line and Gabali respectively [19]. Gestation length of New Zealand white rabbits ranged from 31.8±0.29 to 31.2±0.26 days; litter size at birth ranged from 5.9±0.64 to 6.6±0.52; preweaning mortality rate % ranged from 34.18±4.59% to 21.19±2.5% and that bunny daily weight gain (g/day) ranged from 11.8±0.49 to 13.7±0.48 [20]. The maternal line of a Spanish rabbit breed was investigated and reported that litter size at birth was 9.07, litter size at weaning was 7.79 and litter size at marketing was 6.95 [21].

II. Material and Methods

The present study was conducted during the period from September 2010 to May 2011. In this study two breeds of rabbits New Zealand White rabbit (twenty does and four bucks) and Hyplus breed (twenty does and four bucks) were used. Rabbits were housed individually in wire cages (200×50×50cm) and maintained under identical nutritional and managerial conditions, in well ventilated rabbitry. Average body weight of the two breed was 3.5 and 4kg for New Zealand white and Hyplus rabbit breed respectively at six months of age at this age, the two breeds were divided randomly into two groups, and each group was subjected to a different mating system (first group was naturally mated while the second group was artificially inseminated using semen diluted with egg yolk citrate solution) Each buck was conditioned to semen collection technique by training to react to the artificial vagina in a preliminary period of three weeks at five months age [22]. Induction of ovulation was done by Administration of a Gonadotrophin releasing hormone (GnRH) analogue, as Buserelin (Receptal) administered 0.2ml subcutaneous injection (s/c). Pregnancy was diagnosed by abdominal palpation at the 14th-day post copulation. Does which failed to conceive were re-mated until successful pregnancy. All does were re-mated again 14-day post-partum [23]. The Reproductive and Productive traits to be studied were:

1. Number of services per conception (NS/C): The Number of services per conception for a given doe is calculated as the total number of mating done to that particular doe until conception.
2. Gestation length (G.L. /day): period elapsed from conception until parturition (Korany, 1980).
3. Litter size and litter weight: recorded at 21 days after birth, weaning (30 days) and at marketing age (75 days).
4. Preweaning mortality = $\frac{LSW-LSB}{LSB}$×100.
5. ADG from 21 days until weaning = $\frac{LWW - LW21}{9}$.
6. ADG from weaning until marketing = $\frac{LWM - LWW}{45}$.

III. Statistical Analysis

Data obtained were analyzed by analysis of variance (ANOVA) [24] using SPSS version 16 for means separation. Probability ≤ 0.01 were considered highly significant [25].

Effect of breed and mating technique on productive and reproductive traits:

$$Y_{IJK} = \mu + B_I + M_J + (BM)_{IJ} + E_{IJK}$$

where:

Y_{IJK}: observation to be studied (productive and reproductive traits).

μ: overall mean for all observations.

B_I: effect of breed.

M_J: effect of mating technique.

$(BM)_{IJ}$: interaction between both breed and mating technique.

E_{IJK}: random error.

IV. Results and Discussion

As shown in Table I, there was highly significant difference (P=0.01) between the two breeding techniques (Natural and artificial insemination methods) in the overall mean of Service number. The number of service/conception of natural mating technique is lower than that of artificial insemination for New Zealand white and Hyplus breed. Doe reproduction is regulated by a complex hormonal system in which hypothalamus and pituitary gland play a leading role in the secretion of gonadotrophin releasing hormone produced by hypothalamus level can stimulate both the synthesis and release of two Gonadotrophins: Follicle stimulating hormone and luteinizing hormone at the anterior pituitary Level. These hormones act on the ovaries. Follicle stimulating hormone is mainly responsible for follicular growth and luteinizing hormone controlling the final follicular maturation and inducing ovulation of pre-ovulatory follicles in order to solve poor fertility of the doe rabbits the systemic use of Gonadotrophin hormones is widespread in rabbit farms [26]. While there was a non-significant difference (P>0.05) between the two mating techniques (Natural and artificial insemination methods) and the overall mean of the gestation period at natural mating technique is higher than that of artificial insemination for New Zealand white and Hyplus breed for both mating techniques respectively.

TABLE I. Least Square Means ± Standard Error (LSM ± SE) of the Effect of the Breed and Mating Technique on the Number of Service/ Conception and Gestation Period Number of Service/ Conception and Gestation Period

Breed	M. T	N	NSC X ±SE	GP(days) X ±SE
New Zealand	Natural	50	1.32^{a} ±0.07	30.44^{a} ±0.09
	Artificial	40	1.775^{b} ±0.10	30.35^{a} ±0.09
Hyplus	Natural	40	1.425^{a} ±0.09	30.5^{a} ±0.1
	Artificial	40	1.625^{b} ±0.10	30.425^{a} ±0.1

TABLE II. Least Square Means ± Standard Error (LSM ± SE) of the Effect of the Breed and Mating Technique on Litter Size and Pre-Weaning Mortality

Breed	M.T	N	LSB X ±SE	LS21 X ±SE	LSW X ±SE	LNM X ±SE	PWM X ±SE
New Zealand	natural	50	6.72a ±0.25	5.58a ±0.21	5.26a ±0.19	5.24a ±0.19	19.024a ±2.59
	artificial	40	9.15b ±0.38	7.025b ±0.309	6.8b ±0.35	6.95b ±0.31	24.26a ±3.7
Hyplus	natural	40	7.125a ±0.304	5.7a ±0.29	5.45a ±0.26	5.575a ±0.26	22.61a ±2.2
	artificial	40	8.85b ±0.42	7b ±0.326	6.8b ±0.31	6.55b ±0.36	21.2525a ±2.6

TABLE III. Least Square Means ± Standard Error (LSM ± SE) of the Effect of the Breed and Mating Technique on Litter Weight at 21 Days, Weaning and at Marketing

Breed	M.T	N	LW21(g) X ±SE	LWW(g) X ±SE	LWM(g) X ±SE
New Zealand	natural	50	434.35^{a} ±11.29	619.41^{a} ±16.55	2117.58^{a} ±51.03
	artificial	40	437.88^{a} ±12.2	610.18^{a} ±15.88	2091.62^{a} ±37.91
Hyplus	natural	40	424.66^{a} ±14.39	652.74^{a} ±14.163	2340.24^{a} ±40.43
	artificial	40	441.44^{a} ±15.77	613.29^{a} ±20.345	2144.32^{a} ±48.34

As shown in Table II, there was a highly significant difference (P=0.01) between the two breeding techniques (Natural and artificial insemination methods) and the overall mean of litter size at birth, litter size at 21 days and litter number at marketing at natural mating technique is lower than that of artificial insemination for New Zealand white and Hyplus breed respectively. while a non-significant difference (P>0.05) between the two breeding techniques (Natural and artificial insemination methods) concerning pre-weaning mortality percentage was recorded for New Zealand white and Hyplus breed for both mating techniques respectively. This significant difference can be due to the administration of a Gonadotrophin releasing hormone (GnRH) analogue, which lead to increasing the number of the released follicles leading to significant increase in litter size.

There was a non-significant difference (P>0.05) between the two breeding techniques (Natural and artificial insemination methods) concerning litter weight at 21 days, litter weight weaning and the overall mean of individual weight at marketing for New Zealand white and Hyplus breed for both mating techniques respectively has been represented in Table III. This result was reasonable regarding that the mating technique has no effect on litter weight; and that litter weight until weaning was affected by maternal care and at marketing it was affected by management standards.

There was highly significant difference (P=0.01) between the two breeding techniques natural for New Zealand white and Hyplus breed respectively and artificial insemination method for New Zealand white and Hyplus breed respectively concerning the overall mean of average daily weight gain from 21 days till weaning1, and the overall mean of average daily weight gained from weaning until marketing[2] has been shown in Table IV, which was expected due to the increased litter size related to artificial insemination technique. Where natural mating technique was proven to have higher records than that of artificial insemination; due to the lower number of litter size at birth in case of natural mating technique which lead to better food intake and better maternal care.

TABLE IV. LEAST SQUARE MEANS ± STANDARD ERROR (LSM ± SE) OF THE EFFECT OF THE BREED AND MATING TECHNIQUE ON AVERAGE DAILY WEIGHT GAIN

Breed	M.T	N	ADG[1](g/day) X ±SE	ADG[2](g/day) X ±SE
New Zealand	natural	50	20.56^{a} ±0.88	33.294^{a} ±0.86
	artificial	40	19.14^{b} ±0.901	32.92^{b} ±0.68
Hyplus	natural	40	25.34^{a} ±0.793	37.51^{a} ±0.71
	artificial	40	21.9^{b} ±0.981	34.02^{b} ±0.783

V. CONCLUSION

The use of artificial insemination technique in rabbits leads to significant increase in litter size and decrease in number of service/conception but on the other hand it affects the daily weight gain which is a disadvantage can be avoided by fostering. The artificial insemination technique proved to be an efficient way to increase farm animal production.

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Heba-T-Allah Abdel Moniem Mohammed was born in Ismailia, Egypt on August 18, 1984. She graduated in July 2006 with degree "Very good with honor" form Suez Canal University, Faculty of Veterinary Medicine, and got her master degree (M.V.Sc.) in January, 2012 form Suez Canal University, Faculty of Veterinary Medicine, Animal Wealth Development Department (Animal Breeding and Production) with title "Relationship between artificial insemination and productive performance of rabbits".

She had been demonstrator of animal production: Department of Animal Wealth Development, Faculty of Veterinary Medicine, Suez Canal University, from January 2007 to January 2012; then assistant lecturer of Animal Production from January 2012 till 2014. At September 2014 she got a PhD scholarship from Yangzhou University Faculty of Animal Science and Technology and has been studying there till now. She was assistant lecturer in practical classes of animal production for the third year students at the Faculty of Veterinary Medicine, Suez Canal University (from January 2007 till 2014); and participated in the annual summer field training of the third year students, Faculty of Veterinary Medicine, in Ismailia, Port Said, Suez and Sinai from June 2007 till 2014.

She published a paper in Suez Canal Veterinary Medicine Journal: M. M. Osman, A. I. Elsheikh, and A. M. Heba-t-Allah, "Effect of mating technique on productive and reproductive traits in rabbits," *SCVMJ*, XVII(1), 2012.

Current Address: 48 East Road, Yangzhou City Wenhui Yangzhou University School of Animal Science and Technology.

Email: hebaabdelmoniem518@yahoo.com