Short Communication

rccp Revista Colombiana de Ciencias Pecuarias

Nesting materials for does: Effect on nest building and performance at first parturition¤

Materiales de nido para conejas: Efecto sobre la construcción del nido y desempeño al primer parto

Materiais de ninho para coelhas: Efeito sobre a construção do ninho e desempenho na primeira parição

Maria C de Oliveira[1*], MV, PhD; Sarah CO Lima[1], MV; Sabina A Mesquita[1], MV; Jessica A Silva[1], MV; Yeury S Gomes[1], MV; Youssef A Attia[2], AS, PhD; Higor C Oliveira[1], MV.

[1]*Faculdade de Medicina Veterinária, Universidade de Rio Verde, Rio Verde, Brasil.*

[2]*Department of Arid Land Agriculture, Faculty of Meteorology, Environment and Arid Land Agriculture, King Abdulaziz University, Saudi Arabia.*

(Received: April 7, 2016; accepted: May 23, 2017)

doi: 10.17533/udea.rccp.v30n4a06

Abstract

Background: The material placed into the nest should provide comfort to both does and their kits. **Objective:** To evaluate the effect of different nesting materials on rabbit doe performance and nest building. **Methods:** Thirty primiparous rabbit does were randomized allotted in a block design with three treatments and ten replicates each. The treatments consisted of nest bedding with wood shavings (280 g, control), Tifton hay (220 g), and thin strips of newspaper (200 g). The state of the nest was assessed to evaluate mixing of the material with doe's hair and preservation of the original material. Kit body weight, daily weight gain, and survival rate were evaluated from birth to weaning. **Results:** The nesting material did not affect the mixing level of material and hair, amount of hair in the nest, body weight, daily weight gain, or survival rate of rabbits from birth to 35 d of age ($p>0.05$). However, preservation of original material in the nest was lower when Tifton hay was used ($p<0.05$). Correlations between material type and total number of born alive and the amount of hair, mixture level between hair and material, and material preservation in the nest were not significant ($p>0.05$). No correlation ($p>0.05$) was observed between material preservation and hair presence or mixture level between both. Positive correlation between hair presence and mixture level ($p<0.001$) was observed.

¤ To cite this article: de Oliveira MC, Lima SC, Mesquita SA, Silva JA, Gomes YS, Attia YA, Oliveira HC. Nesting materials for does: Effect on nest building and performance at first parturition. Rev Colomb Cienc Pecu 2017; 30:308-315.

* Corresponding author: Maria C de Oliveira. Faculdade de Medicina Veterinária, Universidade de Rio Verde, Campus Universitário s/n, CEP: 75901-910, Rio Verde, GO, Brasil. E-mail: mcorv@yahoo.com.br

Conclusion: Tifton hay and cut newspaper can be used as nest bedding for pregnant does in replacement of wood shavings, with no negative effects on nest building behavior or kit performance.

Keywords: *alternative material for nest, mothering ability, nesting behavior, rabbit development, rabbit growth.*

Resumen

Antecedentes: El material ubicado en el nido debe proporcionar confort a la coneja y a su camada. **Objetivo:** Evaluar el efecto de nidos forrados con diferentes materiales sobre el desempeño de la coneja y sobre la construcción del nido. **Métodos:** Treinta conejas primíparas fueron usadas en un diseño en bloques al azar con tres tratamientos y 10 repeticiones cada uno. Los tratamientos consistieron en forrar el nido con viruta (280 g), heno de Tifton (220 g) y periódico cortado en tiras (200 g). El estado del nido fue determinado para evaluar la mezcla del material y los vellos de la coneja, la preservación del material original, y el peso corporal, la ganancia de peso diaria y la tasa de supervivencia fueron evaluados desde el nacimiento hasta el destete. **Resultados:** El tipo de material no afectó el nivel de mezcla entre el material y los vellos, cantidad de vello en el nido, peso corporal, ganancia de peso diaria, o tasa de supervivencia de las crías desde el nacimiento hasta el d 35 de edad ($p>0,05$); sin embargo, la preservación del material original en el nido fue menor cuando el heno de Tifton fue usado ($p<0,05$). Las correlaciones del tipo de material y número total de nacidos vivos, y la cantidad de vello, nivel de mezcla entre vello y material, y preservación de material en el nido no fueron significativas ($p>0,05$). No hubo correlación ($p>0,05$) entre preservación del material en el nido con presencia de vello o nivel de mezcla en los nidos. Hubo una correlación positive entre la presencia de vello en el nido y el nivel de mezcla ($p<0,001$). **Conclusión:** El heno de Tifton y el periódico cortado en tiras puede ser usado como revestimiento de nidos para conejas gestantes, sustituyendo la viruta de madera sin efectos negativos sobre el comportamiento de construcción del nido de la coneja ni sobre el desempeño de las crías desde el nacimiento hasta el destete, considerando el primer parto.

Palabras clave: *comportamiento materno, crecimiento de conejos, desarrollo de conejos, habilidad materna, material alternativo para nidos.*

Resumo

Antecedentes: O material colocado no ninho deve proporcionar conforto à coelha e sua ninhada. **Objetivo:** Avaliar o efeito de ninhos forrados com diferentes materiais sobre o desempenho da coelha e sobre a construção do ninho. **Métodos:** Trinta coelhas primíparas foram usadas em delineamento em blocos ao acaso com três tratamentos e dez repetições cada. Foram avaliados três tipos de material para forrar o piso do ninho com maravalha (280 g), feno de Tifton (220 g) e jornal cortado em tiras (200 g). O estado do ninho foi determinado para avaliar a mistura do material com os pelos da coelha, a preservação do material original. Peso corporal, ganho de peso diário e a taxa de sobrevivência foram avaliados desde o nascimento até o desmame. **Resultados:** Nenhum efeito foi observado do tipo de material sobre o nível de mistura do material e pelos, quantidade de pelos no ninho, peso corporal, ganho de peso diário ou taxa de sobrevivência dos láparos do nascimento até 35 d de idade ($p>0,05$), entretanto, a preservação do material original no ninho foi menor quando o feno de Tifton foi usado ($p<0,05$). As correlacões de tipo de material e número total de nascidos vivos com a presença de pelo, nível de mistura entre pelo e material, e preservação de material no ninho não foram significativas ($p>0,05$). Não houve correlação ($p>0,05$) entre preservação do material no ninho com presença de pelo ou nível de mistura nos ninhos. Houve correlação positiva entre a presença de pelo no ninho com nível de mistura ($p<0,001$). **Conclusão:** Feno de Tifton e jornal cortado em tiras podem ser usados como revestimento de ninhos para coelhas gestantes, substituindo a maravalha sem efeitos negativos sobre o comportamento de construção do ninho da coelha nem sobre o desempenho dos láparos do nascimento até o desmame, considerando-se o primeiro parto.

Palavras chave: *comportamento materno, crescimento de coelhos, desenvolvimento de coelhos, habilidade materna, material alternativo para ninho.*

Introduction

Rabbits display nest-building behavior (Baumann *et al.,* 2005). Kits are born immature, with low thermoregulatory capacity. Comfort and body temperature stability of kits are linked to the quality of the material placed in the nest, which will influence rabbit survival during lactation (Zarrow *et al.,* 1963; Rommers *et al.,* 1999). The nesting material should provide a comfortable environment for does and kits, minimizing ammonia production, and should not be dusty (Lanteigne and Reebs, 2006) because dust may cause irritation to the nostrils and eyes of does and kits. Wood shavings are the most commonly used material for nest bedding in Brazil, but due to its scarcity in some regions it is necessary to find substitute materials with no adverse effects on doe and kit performance.

In nature, maternal behavior of rabbits involves selecting a nesting site, building the nest, giving birth to kits, and successfully raising the young kits until weaning. Nest-building begins several days before parturition. Digging, the first behavior, starts 6-8 d before kindling. One to three days before kindling, the doe carries hay or other nesting material in her mouth to form the nest (McNitt *et al.,* 2013), which is followed by lining the nest with her own hair (Nowland *et al.,* 2015).

Endocrinal changes (Canali *et al.,* 1991), nesting season, breed (Szendrö *et al.,* 1988), and type of material used in the nest (Verga *et al.,* 2000) may lead to hair fall in the does. Variations in the construction of the nest are not due the experience but to precise stimuli, such as temperature and endocrine changes (Zarrow *et al.,* 1961; 1963). Nest building is a behavioral pattern that improves over time as a function of experience (Canali *et al.,* 1991).

During early gestation, progesterone levels predominate, but the ratio of estrogen and progesterone levels are reversed near the end of the pregnancy period. These changes may be involved in the initiation of hair loosening and nest building. The shift to estrogen dominance and prolactin secretion seem to trigger nest building at the end of pregnancy (McNitt *et al.,* 2013).

Nest building is an apparently simple activity but it requires great care because the highest mortality rate in rabbits occurs during lactation. Gualterio *et al.* (1988) reported that 54% of preweaning deaths occurred during the first 12 h post-parturition, and Partridge *et al*. (1981) noted that 70% of kit mortalities occurred during the first week after birth. According to Canali *et al*. (1991), the quality of the nest is positively and negatively correlated with the number of weaned and mortality rate, respectively, and the quantity of hair present in the nest is inversely correlated to the ambient temperature. A good nest quality is also important for the protection of kits, as stated by Gonzáles-Redondo and Zamora-Lozano (2008) who reported that 92.3 and 84.6% of kits born in nest with no straw or hair, respectively, were cannibalized. Thus, the use of an appropriate material to line the nests, one that offers a favorable microenvironment for kit survival, increasing the number of kittens weaned, may result into an increase of 36% in profit for the farmer (Eady, 2009).

Therefore, this study evaluated the effect of different materials for nest lining on rabbit doe performance and nest building.

Material and methods

Ethical considerations

This study was approved by the Animal Ethics Committee of Universidade de Rio Verde (Brazil), number 02/13 of May 7, 2013).

Animals

Thirty five-months-old, primiparous, half-breed (New Zealand White × California) does were used. The average ambient temperatures during the experimental period are listed in Table 1.

Table 1. Ambient temperature during the experimental period.

Month	Maximum temperature (°C)	Minimum temperature (°C)
March	31.5	19.7
April	28.5	17.8
May	29.3	18.0
June	29.1	16.6
July	28.8	13.7

The does were individually housed in single-deck wire cages installed inside a building. A 16-h light/8-h dark cycle was maintained using an automatic timer. The does were fed a commercial pelleted formulation (Table 2) and water was continuously available from automatic valves.

Table 2. Diet composition of the feed[1,2].

Parameter	Minimum level
Dry matter (%)	88.00
Crude protein (%)	17.00
Ether extract (%)	3.37
Crude fiber (%)	15.00
Ash (%)	12.00
Calcium (%)	2.00
Total phosphorus (%)	0.75
Lysine (%)	0.94
Methionine + cystine (%)	0.63
Digestible energy (Kcal/Kg)	2,300

[1]Based on natural matter. [2]Content per Kg: Vitamin A 8,000 IU, vitamin D3 1,000 IU, vitamin E 15 IU, vitamin K3 1.50 mg, vitamin B1 2 mg, vitamin B2 5 mg, vitamin B6 2 mg, vitamin B12 10 mcg, folic acid 1 mg, pantothenic acid 18 mg, nicotinic acid 35 mg, choline 500 mg, Co 1.50 mg, Cu 6 mg, Zn 50 mg, I 0.30 mg, Fe 40 mg, Mn 40 mg, Se 0.10 mg, growth promotor 10 mg, antioxidant 125 mg.

Each doe was mated with a buck by placing it in a buck's cage and observing whether mating occurred. Pregnancy was detected 14 d post-mating (day of mating = 0). The experiment was conducted during March-July. The experimental design included randomized blocks with three treatments and ten replicates. Treatments consisted of different materials for nest bedding: A control group with sieved wood shavings (280 g), and two experimental groups with Tifton hay (220 g) and newspaper cut into strips (200 g), all of them placed at a height of 4 cm. Materials were not refilled during the lactation period. Tifton hay and newspapers were chosen due to its availability. Nests were made from wood, and measured 34 × 40 × 30 cm (height, length, and width, respectively).

Three days before parturition nests were placed into the cages and were removed at d 20 after birth. Since placement in the cages, nest status was assessed by an observer twice a day (at 8:30 and 16:30). Nest evaluation consisted of a qualitative analysis based on the criteria described by Blumetto *et al.* (2010): Mixing level between nest material and doe hair (1, no mixture; 2, some mixture; 3, almost the entire material was mixed with the hair); presence of hair (1, no hair in the nest; 2, >50% of the nest had visible material; 3, >50% of the nest had material covered with hair; 4, only hair was observed); and, preservation of the original material in the nest (1, <30% was kept in the nest; 2, between 30 and 60% was kept; 3, <60% was kept).

Nest evaluations concluded at parturition, and nest building ceased after this event (Hudson *et al.,* 2000). The results of most recent nest evaluations were used for statistical analysis and correlations. Body weight, daily weight gain, and survival rate of the kit were determined weekly until d 35 of age. Correlations were determined among hair presence, mixture level, and preservation of the material in the nest with both type of material and total born kits.

Results were submitted to variance analysis using the SAEG (2007). The mean values of nest evaluation were compared using the Kruskal-Wallis test with 5% probability. Tukey's test was used to compare the means for kit size, weight, and their performance from birth to weaning. Correlations were evaluated using Kendall's rank correlation coefficient with 5% probability.

Results

No effect of block was observed on the evaluated parameters ($p>0.05$). No effect of material type was observed on the mixture level between material and hair and on the amount of hair in the nest ($p>0.05$); however, preservation of the original material in the nest was lower when Tifton hay was used ($p<0.005$; Table 3).

The type of material did not influence body weight, daily weight gain, or survival rate of rabbits from birth to d 35 after birth ($p>0.05$; Table 4).

Correlations between material type and total number of born kits, and the presence of hair, level of mixture between hair and material, and material preservation in the nest were not significant ($p>0.05$; Table 5).

Table 3. Nest evaluation on the day of parturition.

Parameter	Material			P-value
	Wood shavings	Tifton hay	Cut newspaper	
Mixing level between material and hair	2.28 ± 0.30	2.14 ± 0.31	2.11 ± 0.23	0.893
Presence of hair in the nest	2.43 ± 0.35	2.57 ± 0.30	2.00 ± 0.21	0.059
Preservation of original material in the nest	2.71 ± 0.13[a]	2.28 ± 0.21[b]	2.89 ± 0.10[a]	0.005

Values are means ± standard error of the mean. Different superscript letters ([a, b]) within rows indicate statistically significant difference ($p<0.05$).

Table 4. Weekly body weight and daily weight gain of rabbits born in nests lined with different materials.

Parameter	Material			SEM[1]	P-value
	Wood shavings	Tifton hay	Cut newspaper		
Total born kits	7.90	8.10	8.10	0.68	0.972
Body weight (g)	57.31	54.12	52.84	2.24	0.368
At 7 d of age					
Body weight (g)	108	115	103	5.16	0.644
Daily weight gain (g/d)	7.38	8.82	7.41	0.67	0.537
Survival rate (%)	94.43	94.63	98.89	1.33	0.285
At 14 d of age					
Body weight (g)	215	202	194	9.35	0.471
Daily weight gain (g/d)	11.33	10.60	10.14	0.64	0.552
Survival rate (%)	85.85	90.32	92.87	2.02	0.377
At 21 d of age					
Body weight (g)	288	297	280	13.74	0.479
Daily weight gain (g/d)	11.04	11.58	10.88	0.63	0.490
Survival rate (%)	85.85	88.32	92.87	2.31	0.481
At 28 d of age					
Body weight (g)	466	466	451	21.18	0.558
Daily weight gain (g/d)	14.63	14.73	14.25	0.74	0.578
Survival rate (%)	85.85	88.32	92.87	2.31	0.481
At 35 d of age					
Total weaned	6.70	7.00	7.50	0.67	0.535
Body weight (g)	699	700	718	28.30	0.864
Daily weight gain (g/d)	18.37	18.46	20.51	1.19	0.877
Survival rate (%)	85.85	88.32	92.87	2.31	0.481

[1]SEM: Standard error of the mean.

Table 5. Correlations between material and total number of born kits and the presence of hair in the nest, mixture levels between material and hair, and material preservation in the nest on parturition day.

Predictors	Correlation	P-value
Material type with		
Presence of hair in the nest	-0.0753	0.653
Mixing level of material and hair	0.0328	0.840
Material preservation in the nest	0.0814	0.624
Total born number with		
Presence of hair in the nest	0.0339	0.819
Mixing level of material and hair	-0.0859	0.573
Material preservation in the nest	-0.0767	0.622

No correlation ($p>0.05$) was observed between material preservation in the nest and hair presence or mixture level of material and hair in the nest. However, there was a positive correlation between hair presence in the nest and mixture level ($p<0.001$; Table 6).

Table 6. Correlation among nest quality traits on parturition day.

Predictors	Correlation	P-value
Hair presence with		
Mixing level of material and hair	0.8368	0.001
Material preservation in the nest	-0.2686	0.094
Mixing level of material and hair with		
Material preservation in the nest	-0.1571	0.339

Discussion

At parturition, the mixing level between material and hair and the amounts of hair in the nest were similar ($p>0.05$) for all materials. These two parameters are important to provide an appropriate temperature for the kits, keeping them warm and comfortable. This is necessary because rabbits are altricial animals and need a warm and soft nest to survive (Patry, 2014); however, the nest lined with Tifton hay had lower ($p<0.05$) original material preservation score, possibly due to its ingestion because the amount on the ground was not different from that observed for the other materials. These results are similar to those described by Blumetto *et al*. (2010), who evaluated nests lined with straw and wood shavings. They did not observe difference among mixing levels of the material and hair, presence of hair in the nest, or preservation of original material. However, Farkas *et al.* (2016) evaluated the quality of nest lined with wood shaving, straw, and hay in terms of amount of hair present and the number of kits covered. They observed that hay was the best material (score 4.11) for nest lining, whereas wood shaving was not appropriate (3.13). Authors also reported that most of the wood shavings stayed in the nest.

Material type did not influence kit performance from birth to weaning, confirming that all materials provided appropriate conditions for growth. Additionally, hay was present in the nest in lesser amount at time of parturition and was not replaced until weaning. An ideal nest material should not only absorb moisture from feces and urine but should release moisture quickly to keep the nest dry and warm. All materials release moisture to the environment, as shown by Garcês *et al.* (2012), who determined that water holding (g H_2O/g) and water releasing (%) capacities of wood shaving, grass, and newspaper are 2.55 and 21.3, 2.54 and 33.7, and 3.39 and 21.5, respectively. Our results agree with those of Blumetto *et al*. (2010), who compared nests lined with straw with those lined with wood shavings. They noted that kits born on different materials presented similar litter size and weight at birth and weaning. The same trend was observed by Farkas *et al.* (2016) who studied the effects of nests lined with wood shavings, straw, and hay on similar parameters.

Mortality rate was similar for all the treatments ($p>0.05$); however, for nests lined with wood shavings or newspaper mortality occurred until the second week, and for those lined with Tifton hay mortality occurred until the third week. This was probably because both wood shavings and newspaper were more preserved in the nest, keeping it warmer. As reported by Hamilton *et al*. (1997), the quality of nest material influenced kit survival initially, but not until weaning. Zarrow *et al*. (1963) demonstrated that kit survival rates in nests lined only with straw, hair, or neither straw nor hair, were 39.39, 92, and 5.71%, respectively, compared with those in nests lined with straw and hair (87.34%), emphasizing the importance for kit survival of both the material and the hair

presence in the nest. Canali *et al.* (1991) and Negatu and McNitt (2002) also reported that a good quality of nest building is important for survival and welfare.

No correlation was observed ($p>0.05$) between material type and total number of newborn kits and the presence of hair, mixture of material and hair, or preservation of the original material in the nest. Although no effect of material was observed, literature reports that a small number of born alive has been associated with higher nest quality building and more hair in the nest (Hamilton *et al.,* 1997).

There was a positive correlation between presence of hair and mixture level of material and hair ($p<0.001$), indicating that the greater the amount of hair, the higher the mixing level and the more structured is the nest. This effect could be due to the prolactin levels at the end of gestation. Hair loosening started close to delivery, when progesterone levels were nonsignificant and high prolactin levels were observed (160 ng/mL), and continued until 3-4 d of lactation, when prolactin was still high (70-85 ng/mL; González-Mariscal *et al.,* 2007). Prolactin levels also stimulate hair mixing into the nest (González-Mariscal *et al.,* 2016). Hamilton *et al.* (1997) also noted a positive correlation between these two parameters.

Tifton hay and newspaper cut into strips may be used as nest bedding for pregnant does in replacement of wood shavings, with no negative effects on the nest-building behavior or kit performance from birth to weaning.

Conflict of interest

The authors declare they have no conflicts of interest with regard to the work presented in this report.

References

Baumann P, Oester H, Stauffacher M. Effects of temporary nest box removal on maternal behavior and pup survival in caged rabbits (*Oryctolagus cuniculus*). Appl Anim Behavr Sci 2005; 91:167-178.

Blumetto O, Olivas I, Torres AG, Villagrá A. Use of straw and wood shavings as nest material in primiparous does. World Rabbit Sci 2010; 18:237-242.

Canali E, Ferrante V, Todeschini R, Verga M, Carenzi C. Rabbit nest construction and its relationship with litter development. Appl Anim Behav Sci 1991; 31:259-266.

Eady SJ. Evaluation of equipment for breeding does housed under Australian meat rabbit farm conditions. Anim Prod Sci 2000; 40:717-720.

Farkas TP, Szendrö Zs, Matics Zs, Radnai I, Mayer A, Gerencsér Zs. Effect of different nest materials on performance of rabbit does. Proceedings of the 11th World Rabbit Congress 2016, 15-18 June, Qingdao, China. p. 197-200.

Garcês A, Afonso SMS, Chilundo A, Jairoce CTS. Evaluation of different litter materials for broiler production in a hot and humid environment: 1. Litter characteristics and quality. J Appl Poult Res 2013; 22:168-176.

González-Mariscal G, Caba M, Hoffman KL, Melo AI. Parental behavior. In: Pfaff DW, Joëls M (ed) Hormones, Brain and Behavior, 3rd ed., Amsterdan: Academic Press; 2016. v. 1, p. 106.

González-Mariscal G, McNitt JI, Lukefahr SD. Maternal care of rabbits in the lab and on the farm: Endocrine regulation of behavior and productivity. Horm Behav 2007; 52:86-91.

Gualterio L, Valentini A, Baglicac M. Effect of season and of parturition order on mortality rate at birth and in the nest. Proceedings of the 4th World Rabbit Congress; 1988 Oct 10-14; Budapest, Hungary. Paris: WRSA; 1988.

Hamilton HH, Lukefahr SD, McNitt JI. Maternal nest quality and its influence on litter survival and weaning performance in commercial rabbits. J Anim Sci 1997; 75:926-933.

Hudson R, Schaal B, Martínez-Gómez M, Distel H. Mother young relations in the European rabbit: Physiological and behavioural locks and keys. World Rabbit Sci 2000; 8:85-90.

Lanteigne M, Reebs SG. 2006. Preference for bedding material in Syrian hamster. Lab Anim 2006; 40:410-418.

McNitt JI, Lukefahr SD, Cheeke PR, Patton NM. Rabbit production. 9th ed., Wallingford: Cabi Publishing; 2013.

Negatu Z, McNitt JI. Hormone profiles and nest-building behavior during the periparturient period in rabbit does. Anim Reprod Sci 2002; 72:125-135.

Nowland MH, Brammer DW, Garcia A, Rush HG. Biology and diseases in rabbits. In: Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, editors. Laboratory Animal Medicine, 3rd ed. Amsterdan: Academic Press; 2015.

Partridge GG, Foley S, Corrigall W. Reproductive performance in purebred and crossbred commercial rabbits. Anim Prod 1981; 32:325-331.

Patry K. The rabbit-raising - problem solver. North Adams: Storey Publishing; 2014.

Rommers JM, Kemp B, Meijerhof R, Noordhuizen JPTM. Rearing management of rabbit does: A review. World Rabbit Sci 1999; 7:125-138.

Szendrö Zs, Kustos K, El-Din SS Hair pull of rabbits does and its relationship with their rearing ability. In Proceedings of the 4th World Rabbit Congress, 10-14 October 1998, Budapest, Hungary. Vol 3: 173-181.

Verga M. Intensive rabbit breeding and welfare: Development of research, trends and applications. In Proceedings of the 7th World Rabbit Congress, 4-7 July 2000, Valencia, Spain. Vol 2:491-506.

Zarrow MX, Farooq A, Denenberg VH, Sawin PB, Ross S. Maternal behavior in the rabbit: Endocrine control of maternal nest building. J Reprod Fertil 1963; 6:375-383.

Zarrow MX, Sawin PB, Ross S, Denenberg VH, Crary D, Wilson ED, Farooq A. Maternal behavior in the rabbit: Evidence for an endocrine basis of maternal nest building and additional data on maternal nest building in the Dutch belted race. J Reprod Fertil 1961; 2:152-62.