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Some information about the Congress : The Congress was organised by the American Branch of the World Rabbit Science Association (65 members from 12 countries, from North- Central- and South-America). There were 270 participants from 11 countries who participated at this Congress (from Mexico, USA, Cuba, Porto Rico, Costa Rica, Columbia, Venezuela, Brazil, Argentina, Belgium, France and Spain) . The 23 abstracts presented below were selected by the authors out of a total of 39 communications.

PRODUCTION SYSTEMS

SYSTEMS, METHODS, AND MANAGEMENT TECHNIQUES IN THE COMMERCIAL RABBIT PRODUCTION UNIT

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Any system that improves productivity is justified, although the pros and cons of its implementation should be analyzed. Based on theoretical considerations, the objective should not be to have more rabbits on a fixed budget, but to have the system going through the actual practice to prove satisfactory economic results. Neither are all work methods applicable in all rabbitries. Not all management techniques offer the best results. In our opinion, each rabbitry is a "small world" and each rabbit producer has a "unique" management style. The truly important thing is not to overlook the REPLACEMENT and to know how to work SURPLUS-LABORERS. Everything should be done with a professional standard and oriented to a main objective: to increase productivity on a HUW (Human Unit of Work) basis.

Key words: Commercial production, systems, rabbits.

SMALL-SCALE RABBIT MEAT PRODUCTION : BACK TO BASICS?

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In the Western Hemisphere, in countries where the demand for rabbit meat is low, and where intensive livestock production systems are common (e.g., commercial broiler, swine, and cattle production), it may not be appropriate for rabbit scientists to recommend commercial rabbit production. Commercial-scale rabbit operations might only be justified, at best, when located in proximity to processing plants and (or) to large cities where there is a strong tradition of rabbit meat consumption. The high cost of producing rabbits translates into high consumer prices, which tends to limit sales to that of a luxury or speciality commodity. An alternative, "back to basics" approach is to recommend small-scale or backyard rabbit enterprises. There are a number of clear advantages to this approach. Such a down-scaled unit could represent a more favorable "economy of scale" of production. Generally, feed costs could be reduced through the utilization of homegrown or less expensive feedstuffs, labor could be shared among family members, and less expensive housing and equipment would be needed. Although productivity may decline, economic returns may exceed costs at a higher rate than for commercial operations. In addition to family consumption, local meat sales could become more competitive because of lower costs of processing and transportation, especially

if there are no rabbit meat inspection laws. Small-scale rabbit production would also support integrative practices (e.g., gardening and vermiculture) and potential local markets for rabbit meat and by-products (e.g., tanned skins and rabbit manure as "organic fertilizer"), which could supplement farm revenue. In addition, there are opportunities to develop poor communities through small-scale rabbit projects. This paper proposes a "cottage industry" model of rabbit micro-enterprise development to secure food and economic stability for rural-based farm families throughout the Western Hemisphere, and to improve the image of rabbit production as a viable activity.

Key words: Rabbits, production, agricultural development, economics, industry.

DIAGNOSIS OF PRODUCTION AND INTAKE OF RABBIT MEAT IN THE VILLAGE OF XOCOTLAN, TEXCOCO, STATE OF MEXICO

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A study was conducted in Xocotlán village, Texcoco county, State of Mexico, in two phases. In the first phase, 20 families who raised rabbits were interviewed before 1989 and again in 1995. Results indicated that before 1989, 70% of the producers grew rabbits and in 1995 only 45%. This decline can be explained by the outbreak of Viral Hemorrhagic Disease. The percentage of producers raising between 1 and 5 does before 1989 was 64% and in 1995 was 55%. Seventy two percent of producers before 1989 produced meat for self-consumption and in 1995 this figure increased to 89%. Moreover, before 1989, 79% of the growers consumed rabbit meat 1 to 2 times per month. This figure declined to 67% by 1995. In the second phase, rabbit production was studied in nine families, five from Xocotlán and four from surrounding villages. One family from Xocotlán recorded an average litter size at birth of 9.5 ± 1.7 kits. However, two families did not produce any kits due to abnormal doe behavior. In general, producers from Xocotlán had the best results in reproduction than those from other communities. The range of rabbit meat consumption per household was between 5.7 to 13.5 kg. The highest rabbit meat

consumption level was detected in the Xocotlán community.

Key words: Small-scale rabbit production.

ECONOMIC ANALYSIS OF RAISING RABBITS IN THE FAMILY BACKYARD UNIT IN OAXACA

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In the present study, an economic analysis was performed to assess rabbit production factors and development trends in the municipalities of the center district of the Oaxaca state, México. A total of 30 producers were involved. The software package SAS (Statistical Analysis System) was used to perform a statistical analysis with a multiple linear regression model consisting of feeding level/quality, herd health status, management level, labor hours, and acquisition of equipment. A coefficient of determination of 63% was obtained. The feeding level/diet quality was more important than the other factors studied. The economic analysis yielded a value of .3 in relation to the cost-benefit ratio. Based on the data, feed costs accounted for 54.87% of rabbit production costs.

Key words: Economic analysis, production, cottage industry.

EVALUATION OF RABBIT PRODUCTION SYSTEMS IN VENEZUELA

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In order to evaluate the status of rabbit production in Venezuela, a farm survey was conducted during 1997-1998. A total of 114 rabbit farms were surveyed. One hundred and seven farms were considered to be very well managed. Taking into account management systems, 23 farms were ranked as intensive, 66 as semi-intensive, and 18 as extensive. The size of the intensive farms was approximately 209 does, 90 does on semi-intensive farms, and 51 does on extensive 51 farms. The most common breeds used were New Zealand Checkered Giant, and Californian. The total annual

production in the country was 279,419 rabbits which was concentrated in Miranda, Aragua, Trujillo, Carabobo, and Tachira states. The reproduction management on the intensive farms was, as expected, more efficient reaching 85.6% fertility. The mean number of parturitions per doe per year was 6.6, 6.1, and 5.3 litters for the intensive, semi-intensive and extensive systems, respectively. The mean number of kits/doe was 7.5. The feeding regime was oriented to the use of concentrates (balanced feeds) and some forages. The total feed consumption was 2,510 MT/year. The most common diseases observed were Myxomatosis (8.4%), Scabies (8.2%), Coriza (7.7%), and Coccidiosis (5.8%). Mortality rate in new-born kits was 18%. Rabbits were sold alive at US\$ 2.70 and slaughtered at US\$ 4.53 per kg. The cost of producing rabbit was US\$ 2.60/kg. We conclude that this activity represents a potential for the diversification of feeds. Secondly, the mentioned breeds are well adapted to the conditions of this country.

Key words: Rabbits, production systems, Venezuela.

WADDING AND PAPER AS NEST MATERIALS FOR DOES

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Paper and wadding were evaluated as nest materials for breeding does. Traits measured were litter size and weight from birth to weaning. Fifty does from a genetic line in development were randomly assigned to treatments in a completely random repeated measures experiment. Parturitions occurred in January and February of 1997. Litter size was not affected by nest material, but litter weight was influenced ($P < .01$). It is necessary that this area of research be extended to other seasons and to take more precise measurements of the does' nest.

Key words: Paper, wadding, litter, nest.

NUTRITION

FATS IN THE NUTRITION OF RABBITS

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Effects of inclusion of fats or full-fat soybeans in rabbit diets were reviewed. Rabbit kits are able to ingest and to efficiently digest large quantities of milk lipids. About 40% of the milk fat consists of medium-chain fatty acids (C8:0 and C10:0). Rabbits digest dietary lipids in a way comparable to other monogastric animals. With the exception of tallow, added fat or oil is nearly 100% digestible, especially at low levels of inclusion. The dietary inclusion of fats or full-fat soybeans is well accepted by rabbits, and does not provoke palatability problems. Growth of fryers is commonly not influenced by dietary fat addition, but due to the increased energy density, a more favorable feed efficiency is obtained. However, a replacement of starch by fat, on an isoenergetic basis, increases the carcass lipid content. In lactating does, dietary fat addition leads to a higher daily DE intake (+ 5%/1% of fat). This additional energy intake is primarily used for increased milk production. Fat addition modifies milk composition and carcass lipids of fryers. The dietary fatty acid pattern has a regulating effect on meat fatty acid content. The major interest for use of fats is to increase the energy concentration of fibrous rabbit diets. However, fat-added diets are only economically acceptable in intensive rabbit meat production systems to favor feed efficiency. Under practical feeding conditions, fat addition is limited to 2-3% in order to maintain the durability of the pellets. Finally, fats also show some potential to reduce thermal stress because, under hot environmental temperatures, energy intake tends to be higher.

Key words: Rabbits, nutrition, fat, review.

SUPPLEMENTATION OF AMINO ACIDS IN DIETS BASED ON FORAGES WITH TWO PROTEIN LEVELS FOR GROWING RABBITS

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Ninety rabbits from a genetic line under development were used to evaluate five different diets for growth traits from weaning to slaughter weight. Four diets were based on high levels of forages (alfalfa and kikuyu grass), with two different protein levels (13 and 16%), supplemented with synthetic amino acids. The other diet was based on soy bean and sorghum. Diets were fed in the form of pellets, animals being fed *ad-libitum*. To date, six replicates per treatment with 3 rabbits per replicates have been studied. Traits studied were average daily gain, feed intake, and feed conversion. The diet with 16% protein and supplemented with amino acids performed the highest daily gains (32 ± 3) and the diet with 13% protein without inclusion of amino acids produced the poorest daily gains (28 ± 6). Feed intake was negatively related to energy concentration in the diet. It was concluded that the use of diets based on a high proportion of forages supplemented with amino acids could be an option for feeding rabbits.

Key words: Rabbits, forage, protein level, synthetic amino acids.

COPPER AVAILABILITY IN RABBIT ORGANS

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This work had the aim to study the deposition of copper in rabbit organs (liver and kidneys) using three sources (copper sulphate, copper oxide and copper carbonate). Copper sulphate was included as the standard. Seventy New Zealand White and Californian rabbits (both sexes and 60 days of age) were housed individually in cages and randomised to seven treatments: A- 0 ppm, B- 20 ppm, C- 40 ppm, D- 80 ppm, and E- 160 ppm of copper sulphate, F- 80 ppm of copper oxide, and G- 80 ppm of copper carbonate. Treatments were not different statistically ($P > .05$) but between organs there were statistical differences

($P < .05$). The bioavailability value for both sources (copper oxide and copper carbonate) was 55.56%.

Key words: Rabbits, copper, organs, deposition, availability.

THREONINE REQUIREMENT OF HIGH PRODUCING RABBIT DOES

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This study investigated the threonine requirements of highly productive doe rabbits. Five diets, each containing levels of .54, .58, .63, .68, and .72% crude threonine were formulated by supplementing a basal diet with L-threonine. Feeding trials were carried out using 370 rabbit does (74 per trial). New Zealand White x Californian does were measured during their reproductive cycles and milk production in 80 lactations. The results indicated that a dietary concentration of .64% of crude threonine (.44% of digestible threonine) should be included to maximize performance of does.

Key words: Rabbits, requirements, amino acids, threonine, reproduction.

THREONINE REQUIREMENT FOR GROWING RABBITS

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Feeding trials were carried out to determine the threonine requirement for growing rabbits. Five diets, containing .54, .58, .63, .68, and .72% crude threonine, were formulated by supplementing a basal diet with L-threonine. One thousand one hundred and fifty weanling rabbits (30-d of age) were used to determine growth performance. A digestibility trial was conducted with 18 rabbits. At the end of the growing period, 105 rabbits were slaughtered with a body weight of 1.8 to 2.0 kg to measure carcass dressing percentage and carcass quality. The results indicated the apparent fecal threonine digestibility (%) was 63.8 ± 1.3 in the basa

diet and 93.0 ± 6.0 for the L-threonine diet, as estimated by the difference method. The optimal values of .60% of crude threonine or .40% of digestible threonine for rapidly growing in rabbits were determined. An excess of dietary threonine tended to impair intake and to increase fat retention in the carcass. This study revealed that threonine should be based on digestible rather than crude units to meet the threonine requirements of growing rabbits.

Key words: Rabbits, requirements, amino acids, threonine, growth.

DISTRIBUTION OF TOTAL, CELLULOLYTIC BACTERIA AND SOME CHEMICAL PARAMETERS IN THE CECAL APPENDIX, CECUM AND COLON OF RABBITS

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Our objective was to compare microbial activity in different sections of cecum and colon, in terms of total and cellulolytic bacteria concentration, in vitro dry matter digestibility (IVDMD) and pH. Ten New Zealand White rabbits were used (average age of 70 days). Samples were obtained from: 1) cecal appendix (AC), 2) thirteenth cecal segment (TAC), and 3) distal colon section (PDC). The pH was highest ($P < .05$) in the AC than in TAC and PDC (7.36, 6.33, and 6.33). The IVDMD was highest ($P < .05$) in AC than in TAC and PDC (56.04, 38.77, and 33.47%). Total bacteria concentration was not different between AC and PDC, but was lower in TAC (1.1×10^{12} , 1.6×10^{12} , and 3.2×10^{10}). Cellulolytic bacteria concentration was considerably higher ($P < .05$) in AC than in TAC and PDC (9×10^7 , 4×10^4 , and 4×10^2). It is concluded that PDC is not representative of cecal-bacterial activity and concentration, and according to the highest cellulolytic bacteria concentration and IVDMD in AC, it is suggested that studies that involve factors affecting cecal microorganisms must consider cecal appendix samples.

Key words: Cecal contents, cellulolytic bacteria, cecumtroph, digestibility.

EFFECT OF ENZYMATIC SUPPLEMENTATION ON GROWTH PERFORMANCE OF RABBITS

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Our objective was to evaluate the growth of rabbits fed diets of increasing levels of an enzymatic complex (VEGPRO^R) with cellulase and protease activity. Seventy-five New Zealand White rabbits were used. Rabbits were weaned at 40 days of age, housed in individual cages, and randomized into five treatments: Control: 0%, A- .05%, B- .10%, C- .15%, and D- .20% of the enzymatic complex. There were no significant differences among the treatments for daily feed intake, daily weight gain, and carcass yield; however, for feed/gain ratio the treatment with .05% of enzymatic complex (treatment A) was better ($P < .05$) than control but equivalent to the other treatments.

Key words: Rabbits, enzymes, growth, supplementation.

GENETICS

SELECTION FOR LITTER SIZE IN RABBITS: POSSIBILITIES OF SELECTION FOR HYPER PROLIFICACY

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First, the common approach of the genetic improvement of meat rabbit is presented involving a three-way cross that was followed for production. Next, the experiments concerning selection of maternal lines for litter size are reviewed, concluding that the responses have been, in general, lower than expected, and that the indirect methods do not show superiority over the direct methods. Afterwards, the alternative approach of selecting on hyperprolificacy was analysed, discussing its theoretical background and the results obtained in experiments with pigs. Finally, one experiment of selecting for hyperprolificacy in rabbits is showed. The aim of this experiment was to create a new maternal line and to examine the results of its evaluation for reproductive, maternal, and growth traits. The

general conclusion is in agreement with the results observed in pigs, showing the interest of the selection on hyper prolificacy to improve litter size.

Key words: *Litter size, selection, hyperprolificacy.*

HERITABILITIES OF POSTWEANING TRAITS OF FOUR RABBIT BREEDS

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Heritabilities for growth rate in Californian, Chinchilla, Semi-Giant White, and New Zealand White rabbits were calculated. Between 5,245 and 7,944 observations in each breed for weaning weight and viability, and between 1,823 and 3,221 records for daily gain were utilized. A mixed-model analysis of variance was used, including sire as a random effect and absorbed fixed effects for consecutive period (month of weaning), sex of kit, number of kindling, and litter size. Heritabilities for weaning weight were .26, .22, .53, and .25, for viability were .03, .02, .08, and .08, for daily gain were .17, .14, .29, and .17, and for final weight (similar for weight per day of age) were .10, .20, .17, and .18 for the four breeds studied, respectively. Daily gain continues to be the best prospective trait for selection for a postweaning weight trait, but studies on weaning weight and weight per day of age as selection criteria for growth, and on weaning weight as an adjustment for daily gain, must be further investigated.

Key words: *Heritability, growth, rabbit.*

HERITABILITY OF INDIVIDUAL BODY WEIGHT AT 56 AND 77 DAYS OF AGE IN A RABBIT POPULATION

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Records and pedigree relationships involving 1,796 rabbits from a new genetic line under development were used to estimate genetic parameters for body weight at 56 (P56) and 77 (P77) days of age. A univariate animal model with inclusion of fixed (mean, year-season, and generation) and random (direct genetic, maternal genetic, common litter, and residual) effects was used to analyse both traits. Derivative-free restricted maximum likelihood was used as the estimation procedure.

Heritabilities for direct and maternal effects were $.101 \pm .055$ and $.158 \pm .100$ for P56, and $.139 \pm .088$ and $.223 \pm .089$ for P77. For common litter and covariances between direct and maternal genetic effects, estimated values were $.378 \pm .046$ and $.209 \pm .089$, and $-.109 \pm .068$ and $-.131 \pm .079$ for P56 and P77, respectively. In order to define the best selection criterion for genetic improvement of this rabbit line, the antagonistic relation between direct and maternal effects should be considered.

Key words: *Genetic parameters, direct, maternal, body weight.*

THE OPTIMAL DESIGN TECHNIQUE IN A RABBIT GROWTH MODEL

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Nine rabbits born from different litters of purebred New Zealand White had their weights measured up to maturity and plotted to reveal their pattern. A Gompertz equation was then fitted and evaluated. Further consideration on the selected model was made to assist the researchers in future trials, whereby the optimal design that requires less weight measurements and animal manipulation was identified. The three design points recommended by the generalized variance criterion set days 1, 50, and 141 as the weights that should be taken. Under such a design, model parameters are more efficiently estimated (smaller standard deviations).

Key words: *Rabbits, growth, optimal design, Gompertz equation.*

MEAT QUALITY FROM CHINCHILLA AND NEW ZEALAND RABBITS UNDER DIFFERENT FREEZING AND AGING TREATMENTS

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The meat quality of 40 rabbits was investigated. Rabbits were from two different breeds: Chinchilla and New Zealand. Live, carcass, and viscera weights of both breeds of animals were recorded. The pH curve was obtained measuring at the following times: 30, 60,

and 90 min, and 3 and 24 h. Loins were treated under freezing and aging treatments. Five loin samples of each breed were frozen with zero or two days of aging period and five loins were aged for two days without freezing before analyses were run. Results agreed that New Zealand's are a heavier breed than Chinchilla. Live, carcass, and viscera weights were significantly heavier for New Zealand compared to those from Chinchilla. The pH curve showed a decline from the initial pH at 30 min to the final pH at 24 h. Freezing treatment had an effect on tenderness. However, aging did not have an effect on the quality of meat. Finally, no difference was found between breeds in shear force values.

Key words: *Rabbit, meat, quality, shear force.*

PATHOLOGY, SANITATION AND OTHER TOPICS

FREQUENCY OF WEIGHING ON BODY AND WEIGHT GAINS ON FATTENING RABBITS OF THE CP1 GENETIC LINE

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A study of growth was carried out using 176 rabbits of the CP1 line of 35 days of age, which were subjected to three frequencies of weighing. The treatments 1, 2, and 3 consisted of weighing the rabbits every 4, 7, and 21 days during the fattening period. Animals were randomly assigned in one of three treatments with 19 replications by treatment, and three animals by replication. The live weights and daily weight gains were not affected ($P > .05$) by frequency of weighing. A growth curve was estimated using all available data. It was concluded that the stress encountered by frequency of weighing did not affect the rabbit's growth performance.

Key words: *Body weight, daily weight gain, prediction equation.*

REPRODUCTION

MATING STRATEGIES TO INCREASE REPRODUCTIVE EFFICIENCY IN RABBITS

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A one year study involving 218 litters sired by 11 New Zealand White bucks and produced by 46 commercial New Zealand White does investigated the effects of mating treatment on reproductive efficiency. Treatments included breeding does once (0), breeding twice at the time of service (00), breeding twice with an interval of one hour (01) or breeding twice with an interval of two hours (02). The 00 treatment resulted in the largest ($P < .05$) total litter size ($7.5 \pm .41$ vs. $6.3 \pm .40$, $6.3 \pm .40$, and $6.4 \pm .41$) and number of kits born alive ($6.5 \pm .47$ vs. $4.8 \pm .46$, $5.2 \pm .46$, and $5.6 \pm .47$). There was no significant difference between 00 and 01 does in the number of breeding treatments required per litter, although the 01 does required fewer treatments ($P < .05$) than the 0 or 02 does ($1.6 \pm .18$ vs $1.9 \pm .18$, and $1.9 \pm .18$, respectively). The 02 does tended to be less productive than the other treatments. There was a strong seasonal influence ($P < .05$) with larger litters and fewer dead kits born in the January to June period. It was concluded that breeding the does twice (00) at the time of service would give the best performance while minimizing the labor requirement.

Key words: *Rabbits, mating, reproductive efficiency.*

RABBIT PRODUCTION IN BRAZIL : SOME REPRODUCTIVE PARAMETERS

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The production of rabbits in Brazil is expanding. In order to characterise the rabbit's major reproductive aspects on one Brazilian farm, 1,479 observations were analyzed from 1995 to 1997. Conception rate in a semi-intensive reproductive rhythm was 63.41%, average number of live rabbits by litter was 7.06 kits with average weight by young rabbit of 50.65 g, and average surviving number by litter at weaning (30 days) was

5.03 kits with an average weight of 627.59 g. These results show that the Brazilian rabbitry is promising and should further increase these production parameters through technological improvements.

Key words: *Rabbitry, rabbit, reproductive parameters.*

EFFECT OF THE SIZE AND COLOR OF THE VULVA ON SEXUAL RECEPTIVITY AND REPRODUCTIVE PERFORMANCE IN ARTIFICIALLY INSEMINATED DOE RABBITS

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A total of 713 inseminations and 431 kindlings from 84 doe rabbits reared since puberty until one year of the production cycle were used in order to determine the effect of the appearance of the vulva on kindling rates (KR) and litter size at birth (LSB). Small vulvas had lower ($P < .0001$) KR (46.7%) than medium (73.1%) and large (80.2%) sizes. The LSB of $8.49 \pm .19$ and $8.92 \pm .29$ in does with medium and large vulva scores were higher ($P < .001$) than does with small vulva size ($7.77 \pm .19$). White and rose vulvas showed lower ($P < .0001$) KR than red and violet colors (27.3% and 36.9% vs 69.4% and 66.1%, respectively). The LSB in red and violet vulvas ($8.09 \pm .24$ and $8.67 \pm .15$) were higher ($P < .0001$) than rose colored vulvas ($7.01 \pm .31$). The relationships between the appearance of the vulva with receptivity are discussed.

Key words: *Vulva appearance, oestrus, insemination, rabbits.*

EFFECT OF PERIODS OF SUPPLEMENTATION WITH WHEAT GRASS ON OESTRUS SYNCHRONIZATION AND REPRODUCTIVE PERFORMANCE IN ARTIFICIALLY INSEMINATED DOE RABBITS

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A total of 48 New Zealand white rabbits were used in order to determine the effect of periods of supplementation with hydroponic wheat grass (as a source of 6-methoxybenzoxazolinone) on receptivity rates (RR), kindling rates (KR), and litter size at birth (LSB) under an artificial insemination program during 3-4 consecutive kindlings. The rabbits were assigned randomly to one of four treatment groups as follows: T1 - 8 days; T2 - 6 days; T3 - 4 days, and T4 - 0 days of supplementation (control group). The grass supplementation in nulliparous females started when they reached 3.2 to 3.6 kg of body live weight, and at the day of kindling in multiparous females. They received 500 g of grass daily. Average daily grass consumption (expressed on a dry matter basis) for T1, T2, and T3 were 103.5 ± 2.37 , 100.6 ± 2.34 , and 98.4 ± 2.15 g, respectively. The RR was influenced by the periods of supplementation ($P < .006$). Control treatment animals had the lowest receptivity rate (34.6%) than those that received the supplement during 4, 6, and 8 days (48.3%, 67.3%, and 68.7%, respectively). There were no differences ($P > .05$) between treatments for reproductive performance traits. The KR for 0, 4, 6, and 8 days of supplementation were 65.4%, 70.7%, 83.7%, and 70.8%, while the respective LSB values were $6.91 \pm .42$, $7.83 \pm .38$, $7.93 \pm .38$, and $8.29 \pm .42$ kits. The effect of supplementation on receptivity in nulliparous and lactating does are discussed.

Key words: *Reproduction, 6-methoxybenzoxazolinone, insemination, rabbits.*