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ECONOMY

CHARACTERIZATION OF SMALL SCALE RABBIT PRODUCTION IN TEXCOCO, MEXICO

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A survey was held to characterized homes in Texcoco county, in relation to the production of rabbit at a family level. Out of 40,000 homes, a random sample of 398 was chosen. Sampling was done without replacement using the maximun variance proportion criterium at a 95% confidence level. In 5% of all homes rabbit was produced under small scale. These units were characterized by having 3.1 (2.39,3.80) dows and 0.8 (0.47,1.13) bucks. The monthly mean production per dow was 2.26 rabbits with a slaughter weight of 2 kg. Rabbit population size estimated was of 13,140 with 5,580 dows, 1,440 bucks and 6,120 fattening rabbits. Based on the figures given, in Texcoco county the monthly production under family scale units was of 12,600 rabbits. Rabbits were sold to the final consumers 32%, restaurants, cafeterias,

intermediaries and others 17% each. Production was characterized by using pelleted feed by only 30%, livestock obtained mainly from other producer 46%, wood cages 35%, second hand containers for feeding and watering 65%, no extension services 80% and no production records 75%.

Key words: production, rabbits, family units.

CONSUMPTION AND PREFERENCE OF RABBIT MEAT IN TEXCOCO, MEXICO

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A sampling survey was held to characterized homes in Texcoco, in relation to consumption and preference of rabbit meat. Out of 40,000 homes a random sample of 398 was chosen. Sampling was done without replacement using the maximun variance proportion criterium at a 95% confidence level. In 75% of all homes rabbit meat had been eaten. The estimated mean consumption per home in 2000, was 1.483

kg/year, which lead to an estimated consumption of 0.241 kg/hab/year and a total amount consumed in Texcoco county of 59.314 tons/year of rabbit meat. Rabbit meat was consumed at home 74%, in other homes 13% and at restaurants 13%. For people having rabbit meat at home, 52% bought it, 20% got it as a present, 25% have or use to have their own meat production and 3% did not know. The meat price in USA dollars varies according to the presentation, the kg of fresh carcass was from \$3.5± 0.23 to \$3.6± 0.22 with and without head respectively, and the price of refrigerated carcass varied from \$4.5± 0.73 to \$4.7±0.61 with and without head, while the price per kg of alive rabbit was \$2.0±0.23.

Key words: consumption, rabbit meat.

EFFECT OF TRANSPORT DURATION
AND SEX ON CARCASS
AND MEAT QUALITY OF GROWING
RABBITS

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In order to evaluate the effect of transport and sex on carcass and meat quality, 204 rabbits were sexed and reared in individual cages from 35 d of age until slaughter at 77 d (average live weight at breeding: 2662±189 g). Before slaughter, four groups of rabbits were constituted and transported for 2, 4, 6, and 8 hours from the breeding to the slaughterhouse. Increasing the duration of transport increased transport losses (from 2.44% to 4.59%; $P<0.001$), decreased dressing percentage on live weight at breeding (from 59.5% to 58.9%; $P<0.01$) and increased the red index of the longissimus dorsi muscle (from 2.38 to 2.73; $P=0.05$). Commercial carcass evaluation for

color, conformation and fatness was not affected by transport duration. The effect of sex was appreciable at slaughter: final live weight and transport losses were higher in females than males. Dressing percentage was lower in females (59.1 vs 59.8%; $P<0.01$) due to the higher gut incidence. Carcasses of females showed a higher longissimus muscle incidence ($P<0.01$). The meat of females was darker (L^* of biceps femoris muscle: 54.9 vs 55.9; $P<0.01$) and less colored (C index of longissimus lumborum muscle: 3.52 vs 3.87; $P=0.04$) than males.

Key words: rabbit, transport, sex, meat quality

MECHANICAL DEBONING OF RABBIT
CARCASSES

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Ninety-one New Zealand White and Altex x New Zealand White fryers were sacrificed at 8, 12, 16 or 20 weeks and stored at -40 C. Later the carcasses were thawed, split into fore and hind halves and mechanically deboned with a Baader 603 belt-and-drum deboner with drums having 1.3 or 2.0 mm apertures. Mince recovery was highest ($P<0.01$) for the 12 and 16 week carcasses (70.1 and 68.8%, respectively) and lowest for the 20 week carcasses (63.1%). Recovery with the 2 mm drum was greater ($P<0.01$) than with the 1.3 mm drum. Recovery was 71.5% for rear halves and 63.0% for fore halves. Age and carcass half did not affect percentage bone. There was more bone in the mince recovered with the

2.0 mm aperture than with the 1.3 mm ($P<0.01$). Deboning time for the eight week carcasses (1.4 0.0 sec.) was half that of the other ages ($P<0.01$). Hind halves passed through the machine more rapidly ($P<0.01$) than fore halves. Age and carcass half had no significant effects on percentage of bone fragments in the mince less than 0.5 mm. The percentage of fragments greater than .85 mm was less ($P<0.05$) for 12 week carcasses than for other ages but was not affected by carcass half. Calcium contents of mince from front and rear halves were 0.064 0.022 and 0.060 0.038 %, respectively. Mechanical separation of rabbit carcasses is fast and efficient, but further refinement is required to meet the U. S. Department of Agriculture standards for percentage of bone fragments.

EFFECT OF AGE AND BODY WEIGHT ON SOME SLAUGHTER PARAMETERS OF GROWING RABBITS

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A total of 238 Pannon White growing rabbits were slaughtered at 10.5, 12 or 13.5 weeks of age, at an average body weight of 2.53, 2.84 and 3.15 kg, respectively. Within each age groups five body weight categories were formed in such a way that the weight difference between two neighbouring age groups and weight categories was equally 0.3 kg. The design of the experiment permitted the separate examination of the effects exerted by age and body weight on some slaughter traits. Older and heavier

rabbits equally had a significantly higher dressing percentage. The ratio of the fore part of the carcass was significantly higher in rabbits of higher body weight but decreased parallel with age. The ratio of the intermediate part of the carcass was significantly higher in the heavier rabbits but was not influenced by age. The ratio of the hind part of the carcass significantly decreased with increasing body weight but increased parallel with age. Thus, it can be concluded that age and body weight sometimes have a synergistic effect while at other times exert an opposite influence on the ratio of the different carcass parts.

GENETICS

EVALUATION OF RESPONSE IN MEAT RABBIT SELECTION PROGRAMS

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Different evaluation methods of response were compared in two selection experiments involving litter size on uterus capacity. Mainly, direct methods were evaluated based on the study of the differences between selected, non-selected or less-selected populations, and indirect methods, based on the solution of mixed models or Bayesian inference. It was shown that in several cases the indirect methods yields very different results than the direct methods, which makes its application

questionable. On the other hand, in all the analyzed experiments, there was a response to litter size, although the prenatal component responsible of such response seemed to be different according to selection line. In one line, ovulation rate was responsible for the response, while in other lines foetal survival was responsible, and in a third line the ovulation rate but mainly foetal survival was responsible.

Key words: selection methods, selection response, litter size, uterus capacity.

CARCASS TRAIT EVALUATION OF THREE RABBIT BREEDS

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Forty-two rabbits of each breed, New Zealand, Californian and Chinchilla were slaughtered at 70 days of age with the objective of evaluating certain carcass traits. A fixed model analysis was used which included effects of breed, sex, and their interaction and slaughter body weight as covariable. Differences among breeds were found ($P<0.05$) in front and back weights, leg weight and body width, being better for Chinchilla. The sex effect was important ($P<0.05$) for the hot carcass content and kidney weight, being higher in females. There was no interaction due to breed x sex effect, except for posterior body weight. The slaughter body weight had an important effect ($P<0.01$) for all carcass traits except in back, carcass and liver weights.

Key words: rabbits, carcass, breed, meat production.

BREED BY SEASON OF WEANING INTERACTION IN RABBITS DURING THE FATTENING PERIOD

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Data of 26,534 rabbits were used to analyze the interaction between breed (Californian, Chinchilla, Semigiant and New Zealand) x month or period grouped by two or three adjacent months, in which weaning took place with three different models which also included year of weaning (1989 to 1996), sex (2), litter size (8), and parturition number (9) and the interaction year x period grouped in two or three months. Body weight and body weight by age at weaning, daily gain, body weight by age and final weight adjusted to 90 days, were analyzed. An analysis of variance was done using the GLM SAS program. Model fit was relatively low ($R^2 = 0.18$ to 0.29), but significance ($P<0.01$) and its variance represented 0.99 to 1.96 % of the total variance in the monthly model. The interaction variance was in general larger than the other sources of variation. Performance diminished from January to December, but breeds did not show it in a homogeneous manner. The Californian breed showed the higher seasonal variation with the highest decline in the warmer months in weaning traits. The New Zealand had the lower variance due to monthly fluctuations. Chinchilla and Semigiant had intermediate patterns compared to the other breeds. The Californian was the most consistent throughout the months. In terms of the breed x season interaction, it is more important to consider the weaning month than the period

of year grouped by two or three months.

Key words: growth, breed, season, interaction.

BAYESIAN ESTIMATION OF GENETIC
PARAMETERS FOR LITTER SIZE
COMPONENTS

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Unilateral ovariectomized does were used for an experiment involving divergent selection for uterine capacity. Throughout the laparoscopy technique, ovulation rate (TO) and implanted embryos (EI) were counted in the second parturition. In most of the does, the uterine capacity (CU), evaluated as litter size at birth, was registered during the first four parturitions. These genetic traits were subjected to a Bayesian multivariate analysis. The estimated heritability for TO, EI and CU was 0.36, 0.21, and 0.10, respectively. The estimated genetic correlation between TO-EI was 0.93, TO-CU was 0.55, and EI-CU was 0.68. The TO genetic determination suggests that in rabbit, the litter size could be improved through ovulation rate selection.

Key words: litter size, uterine capacity, ovulation rate, Bayesian inference.

GROWTH TRAIT PARAMETERS IN
FOUR RABBIT BREEDS

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Genetic parameters for growth traits in Californian, Chinchilla, Semigiant and New Zealand White breeds were estimated through a sire model (MP) and an animal model (AIREML). A total of 6,140 to 12,477 weaning weight records (PD) and 3,333 to 7,860 daily gain records (GD), and final weight (PF) by breed in the sire model, and 4,496 to 9,798 breed records for AIREML analysis were used. The sire effect was considered as random by the MP, and all other effects consisting of month-year of birth (1989 to 1997), six parturition classes, and litter size were absorbed. Two analyses were done by AIREML, one with fixed effects similar to MP and another that used PD instead of litter size, both with direct maternal and litter genetic effects. According to the MP, estimated heritabilities were between 0.23 and 0.54 for PD and between 0.13 and 0.18 for GD and PF, except for Semigiant (0.23 to 0.24). Heritabilities of PD for direct effects by AIREML were lower (0.05 to 0.19) than by MP, linking a great portion of the variability (0.62 to 0.74) to the litter and a small part due to maternal effect. For GD and PF, direct effect heritabilities were similar (0.15 to 0.21) to MP with no evidence of maternal effects, and a higher litter effect variability (0.18 to 0.29). The phenotypic and genetic correlations were homogeneous among breeds. There were genetic correlations between GD and PF (0.64 to 0.87), but they were low between PD and GD. Some emphasis of PD and GD

needs to be considered in growth selection while improving the environmental test conditions.

Key words: heritabilities, correlations, growth, pure breeds.

DAM AND LITTER INBREEDING
EFFECTS ON LITTER SIZE AND WEIGHT
OF NEW ZEALAND WHITE RABBITS IN
MEXICO

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A study was carried out to evaluate dam and litter inbreeding on litter size at birth (LSB), litter size at weaning (LSW) and litter weight at weaning (LWW) of New Zealand White rabbits. Two hundred and thirty three observations were analysed, practicing inbreeding by means of full-sibs and parent-offspring matings, with an inbreeding coefficient between 0 and 37.5% in the dams and between 0 and 46.9% in the offspring. Dam inbreeding affected ($P<0.01$) LSB; a reduction of 10.42 kits was observed per every 1% of inbreeding in the dam. No significant effects of litter inbreeding on any variable were observed. Number of kidding affected only LSB; averages increased from the 1st to the 4th kidding and later decreased gradually to the 8th kidding. Season of kidding affected ($P<0.01$) LSW and LWW; even though there were high averages in certain seasons, the performance for both variables was very irregular. For every kit

born LSW was increased by 1.64 kits, and for every kit in the litter at weaning LWW was increased by 720 g. Among the three lines, the genetic line no. 1 had the highest LWW, due to a higher LSW. It is concluded that only dam inbreeding affects litter size and weight of New Zealand White rabbits.

Key words: inbreeding, rabbits, litter, reproduction

SELECTION RESPONSE FOR 70-DAY
BODY WEIGHT IN A THREE-BREED
RABBIT POPULATION

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The objective of this paper was to evaluate the selection response of weight at 70 days of age (P70), through 5 generations in a three-breed rabbit population: New Zealand White, Californian, and Chinchilla. The base population was formed by 221 breeding animals with a genotype established during the four previous years. Four does were assigned at random for mating to each sire, and several traits were evaluated in the progeny: Number of kits at birth (NGN), mean litter weight at birth (PN), litter size at weaning (NGD), individual weaning weight (PD), and weight at 70 days (P70) were measured. The following results were obtained in the first generation: NGN 7.99, PN 64.03 g, NGD 6.95, PD 722 g, and P70 1,862 g, and for the fifth generation: NGD 7.82, PN 68.47g, NGD 6.33, PD 846.16 g, and P70 2,017 g. The total selection response during the 5 generations amounted to 1.95% for NGN, 11.8% for PN, NGD showed no change, 16.9% for PD, and 10 % for P70.

Key words: selection, rabbits.

QUALITY SYSTEM OF GENETIC
MANAGEMENT IN THE CENPALAB
RABBIT COLONY.

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In this study, a control system for genetic management of the rabbit colony that allows regular activities to be fully carried out is presented, including analysis, definition, and drawing up and establishing procedures for each of the breeds produced at CENPALAB. This is indispensable for the obtaining and reproduction of the different breeds needed to satisfy the big demand for this biological model, the rabbit, necessary for the performance of much biomedical research. The genetic quality of the laboratory animals is a critical factor in the success of experiments. The highest quality of care and handling is the first line of defence for protection of genetic integrity. This is something that cannot be substituted by any monitoring system or genetic laboratory control, however complete and sophisticated these may be.

NUTRITION

ROLE OF DIETARY FIBRE IN RABBIT
NUTRITION AND IN DIGESTIVE
TROUBLES PREVENTION

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This paper review recent studies dealing with the nutritional role of dietary fibre, and on their impact on digestive health of the rabbit. Results show clearly that a minimum dietary fibre supply is essential to prevent digestive troubles in the growing rabbit. The most recent fibre recommendations have implicated several classes of fibre, including low-digested fibre (lignocellulose) and digestible fibre (hemicelluloses and pectins). The present review focuses also on the nutritional role of the digestible fibre for the rabbit that was less studied. To allow the formulation of complete feeds with adequate fibre levels, a synthetic table summarising the levels of several fibre classes (including digestible fibre and pectins) in some raw materials classically used in rabbit feeding is given. A brief overview of some characteristics of dietary fibre and of some routine methods to estimate fibre fractions in animal feed ingredients is first presented.

FEEDING RABBITS WITH SUGAR CANE

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One of the chief limits to rabbit production in the Tropics has always been

the lack of information on feeding with suitable local resources. Referring to this in a study on the use of tropical forage for rabbits, Raharjo et al (1986a) concluded that, unlike tropical woody legumes, tropical grasses were not generally suitable for rabbits, having a low digestibility of between 10 and 15%. Another unclear factor, sometimes contradictory, is the need to provide concentrates and the form in which to provide them, granules or pellets; or when forage is used, the optimum proportion in the diet either of concentrates (Sánchez et al 1984a) or of pellets (Pote et al 1980). The size of the particle is also controversial; if this is reduced they apparently reach the small intestine too soon and accumulate in the caecum where they can cause diarrhoea (Lang 1981, Leplace and Lebas 1977, quoted by Sánchez et al 1984a). As regards the level of protein, Cheeke et al (1985) studied levels for breeding females and animals for consumption of 20.5, 19.0 and 17.5% in pelleted feeds and found that the lowest level of 17.5% sufficient for both purposes. But the climate was temperate, feeding was ad libitum and perhaps the rabbits exposed to a diet with 17.5% protein simply consumed a greater quantity of soft faeces, since apparently the degree of cecotrofia depends on the level of fibre and protein in the diet (Fekete 1985). In the Tropics, the high temperature and humidity can affect both reproductive and productive behaviour of rabbits. However, a breeding female can produce in a year, at a conservative estimate, 25 rabbits for consumption of 1.8 kilos each; about 45 kilos live weight or 25 kilos of consumable meat.

TROPICAL FORAGE SOURCES FOR RABBIT DIETS

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In recent years, the use of forages for feeding rabbits has increased in tropical countries. This is an alternative practice that allows sustainable ecological and economical production. However, very little is known about the nutritional value, physical-chemical properties, chemical composition and the anti-nutritional factors of these forage sources and how they affect the digestive system and factors that could limit their inclusion in rabbit diets. These objectives will be analyzed in this study

PHYSIOLOGICAL CONSIDERATIONS REGARDING THE USE OF TROPICAL FORAGE SOURCES AS A RABBIT FEEDS IN CUBA

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Results from four experiments carried out between 1997 and 2001 at the Institute of Animal Sciences were used to determine *in vivo* and *in vitro* effects of different forage sources on the digestion of nutrients, the production of total and individual short chain fatty acids chain and on the morphology and the content of the digestive tracts of growing rabbits. There was lower digestibility ($P<0.01$) of dry matter of *Vigna unguiculata* (cowpea leaves) at the stomach

level than for alfalfa, dried citrus meal or fermented citrus pulp with *Aspergillus niger*. Mulberry leaves and stems and sugar cane meal without added chicken manure had the highest digestibilities of neutral detergent fiber ($P<0.001$). There was less cecal content ($P<0.01$) from treatments with greater amounts of sugar cane meal and a lower stomach weight with values of 30.09, 28.7, 26.76 and 26.30 g for diets with 0, 15, 30 and 45% cane meal, respectively. Liver weight decreased ($P<0.01$) but there was no effect on liver function when sugar cane meal was included at 15%. Citrus meal at 10% in the diet increased the digestibility of neutral detergent fiber ($P<0.05$) and nutrient consumption ($P<0.001$). The results suggest a major nutritional potential for the citrus meal, citrus silage, sugar cane meal and mulberry. It was also determined that up to 45% cane meal in the diet did not affect liver function, but there was an effect of that level on the digestion in the large intestine. Substitution of alfalfa for 10% of the citrus meal improved the efficiency of utilization, primarily neutral detergent fiber, and stimulated feed consumption.

Key words: digestion, fiber, citrus, sugar cane, forage

AMARANTH (*Amaranthu spp.*) STEM AND LEAF MEAL AS AN INGREDIENT IN DIETS FOR GROWING AND FATTENING RABBITS

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This study was performed in the state of Tachira, Venezuela using 36 New Zealand White kits 35-40 days old. Nine kits were randomly assigned to each of four

treatments: T1-20% amaranth, T2-25% amaranth, T3-30% amaranth, and T4-commercial feed. The consumption of dry matter was higher ($P<0.01$) for T4 than for T1, T2 or T3. The values were 110.4, 62.7, 78.9 and 72.8 g/d, respectively. The daily weight gain was higher ($P<0.01$) for T4 than for T1, T2, or T3. The values were 29.8, 15.3, 19.9 and 19.1 g/d, respectively. There were no differences in feed conversion or carcass yield. The digestibilities of dry matter, organic matter and crude protein were similar for all treatments. The digestibility of crude fiber was highest (52.4%) for T4 and T1 (54.1%) ($P<0.05$). When the level of amaranth was increased in the feed, the weight of the empty digestive tract also increased. It was concluded that it is necessary to increase the intake of dry matter in diets that contain amaranth with the goal to increase weight and be able to compete with the commercial feed.

BIOAVAILABILITY OF DIFFERENT COPPER SOURCES FOR GROWING RABBITS

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One hundred and forty 60 days old New Zealand White and Californian rabbits from both sexes were assigned to 14 experimental treatments with the objective of determining copper (Cu) bioavailability of three inorganic, copper oxide (OC treatment), copper sulphate (SC treatment), and copper carbonate (CC treatment), and one organic source, copper chelate (QC treatment), used

in the concentrations of 0, 20, 40, 80 and 160 ppm for the standard curve. The highest feed intake occurred in the 80SC treatment and the lowest in the 160QC treatment ($R^2 = 0.19$). For body weight gain the best treatment was 80SC and the worst 80CC ($R^2 = 0.24$). For feed conversion the treatments 80CC, 80SC, 0C, 20SC, and 80QC showed in this order the highest values, while the lowest was in 40QC. For liver copper, the 160CC treatment showed the highest value, and 80SC and 40SC the lowest. There were no sex differences, but the New Zealand White rabbits showed higher copper deposition. Based on the results the following regression equation was obtained: $Y_{Cu} = 1.37 + 3.83x_1 + 2.77x_2 + 2.83x_3 + 2.84x_4 + 2.84x_5$ ($R^2 = 0.33$).

Keywords: bioavailability, copper, inorganic source, organic source, rabbit

PERFORMANCE OF GROWING RABBITS
FED DIETS CONTAINING DIFFERENT
LEVELS OF TRITICALE PROCESSED OR
NOT BY EXTRUSION¹

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The experiment was conducted with the objective of evaluating the performance of growing rabbits fed diets containing different levels of replacement of corn by triticale, either extruded or not. Ninety eight New Zealand White rabbits, 49 males and 49 females, during the period of 35 to 75 days of age, were assigned to a completely randomized design, with seven treatments and 14 replications. The treatments consisted of a control non-processed common corn based diet and

six other diets where 33, 66 and 100% of corn was replaced by triticale, either extruded or not. The regression analysis did not reveal any effects ($P > 0.05$) of corn replacement by the increasing levels of triticale and extruded triticale on the performance and carcass traits of growing rabbits. It can be concluded that corn may be completely replaced by triticale, extruded or not, in the diets. The use of triticale in the diets will depend on market price and availability.

Key words: corn, extrusion, growing rabbits, performance, triticale

PRODUCTIVE RESPONSE AND CEACAL
FERMENTATION IN YOUNG RABBITS
FED WITH INOCULOS OF CEACAL
BACTERIA

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Two bacteria from the rabbit ceacum were isolated (*Clostridium sordellii* and *Prepostretococcus tetradius*) with the aim of evaluating the effects of microbial additives on the productive response and ceacal fermentation in growing rabbits. Sixty New Zealand rabbits were used of 38 days of age and three treatments were assigned; 1) control diet 2) and 3) control diet + bacterial additives. Readings were taken of indicators of food consumption, live weight gain (LWG) and alimentary efficiency (AE). In the third and fifth week of the experiment a digestibility test was performed. The rabbits were slaughtered at the age of 77 days and samples were taken from appendix,

13th ceecal segment and distal colon. From the samples measurements were made of total bacteria concentration (TB) and cellulitic bacteria (CB), pH, concentration of NH₄ and volatile fatty acids (VFA). LWG, consumption and AE gave a partial response ($P < 0.05$) during the experiment, with the use of additives. The greatest effect of the cultures was on the digestibility of detergent acid fibre, where significant increments were obtained ($P < 0.05$). The concentration of TB was greatest in the distal colon, with the use of additives. Also, the concentration of CB was greatest in the distal colon, while *P. tetradius* reduced ($P < 0.05$) the concentration of NH₄ in the ceacum. The concentration of VFA rose ($P < 0.01$) with the inclusion of *C. sordellii* in ceacum and colon. The results obtained suggest an evaluation of different levels of additiveness in studies of productive behaviour, and also their use is recommended in diets of high fibre content

PERFORMANCE OF GROWING RABBITS
FED DIETS CONTAINING DIFFERENT
LEVELS OF EXTRUDED CORN

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With the objective of evaluating the performance of growing rabbits fed diets containing different levels of corn replaced by extruded corn, 80 New Zealand White rabbits, half from each gender, were used from 35 to 75 days of age. The animals were assigned to a completely randomized design with four treatments and 20 replications. The treatments consisted of four isoenergetic diets, being one control non-processed common corn based and other three diets

where 33, 66 and 100% of common corn was replaced by extruded corn. The inclusion of increasing levels of extruded corn in the diets did not affect ($P > 0.05$) average daily gain, feed conversion, carcass weight, and dressing percentage, but linearly reduced the average daily feed intake. It can be concluded that extruded corn may completely replace common corn in growing rabbit diets; its use will depend on price and market availability.

Key words: extrusion, growing rabbits, performance, rabbit

EFFECT OF SUPPLEMENTAL USE OF
FORAGE FROM GREEN HYDROPONIC
BARLEY IN THE PRODUCTION
INDICATORS AND CARCASS YIELD
DURING FATTENING

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The objective of this investigation was to evaluate the effect of adding 0%, 10%, 20% or 30% green hydroponic barley forage (FVHC) on the production indicators and yield of New Zealand rabbits during fattening. Sixty four 35 day old New Zealand White rabbits were distributed in the four treatment groups with four replications of four rabbits in each group. There was a difference in weight gain (GP) ($P < 0.05$) in favor of treatments 0 and 10%. There were no differences in carcass yield and feed conversion (CA). The results obtained for weight gain, feed conversion and carcass yield for 0% were 1290g, 3.35 and 58.62%; for 10% were 1260g, 3.23 and 58.27%; for 20% were 1155g, 3.26, and 58.05%; and for 30% were 1091g, 3.22 and 57.50%, respectively. In conclusion, its possible to

add up to 10% FVHC in rabbit feed for New Zealand White kits during the fattening stage with no effect on production or carcass yield.

DIFFERENT VEGETABLE OIL SOURCES IN DIETS AND THE FAT ACIDS PROFILE IN THE GROWING RABBITS MEAT

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To evaluate the diets with the addition or not of 3% of canola oil, corn oil or soybean oil on the chemical composition of rabbit meat, 100 animals were slaughtered – 20 at 35 days old, 40 at 50 days old and 40 at 70 days old. The 35-days-old slaughtered animals were from litters whose mothers received the same experimental diets, since their birth, evaluated after weaning. After the slaughter, the right leg meat of each animal was collected and grouped in three composed samples for chemical analysis, for each group receiving a respective experimental diet. The oil addition to diets increase the fat in the rabbits' leg meat, especially the diet with corn oil, while the diet with canola oil provided carcasses with higher protein. With the age advance, a linear decreasing of moisture and protein and an increasing in the deposited fat was observed, independently of the diet. The fatty acids profile deposited in the meat reflects the composition in the experimental diet. The oil addition to the diets, independent of the source, decreased the saturated fatty acids and increased the unsaturated fatty acids in the rabbits' meat. The diet with canola oil provided meat with higher w3 and monounsaturated fatty acids and lower w6, resulting in the lower w6: w3 ratio. The corn oil and soybean oil addition to the diets

provided meat with higher polyunsaturated fatty acids and with the highest fatty acids w6: w3 ratio.

BIOAVAILABILITY OF DIFFERENT ZINC SOURCES FOR GROWING RABBITS

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One hundred and forty 60 days old New Zealand White and Californian rabbits from both sexes were assigned to 14 experimental treatments with the objective of determining zinc (Zn) bioavailability of three inorganic, zinc oxide (OZ treatment), zinc sulphate (SZ treatment) and zinc carbonate (CZ treatment), and one organic source, zinc chelate (QZ treatment), used in the concentrations of 0, 50, 100, 150 and 200 ppm to obtain the standard curve. The highest feed intake occurred in the 50OZ and 100OZ treatments and the lowest in the 200OZ, 100SZ, 200SZ and 200QZ treatments ($R^2 = 0.18$). For body weight gain the best results were for the treatments 50OZ, 100CZ, 200CZ, 100SZ, 200SZ, 100QZ and 200QZ, whereas the treatments OZ and 100OZ showed the lowest values ($R^2 = 0.23$). For feed conversion the treatments OZ, 100OZ, 150OZ and 150SZ showed the highest values, and the lowest values were for the treatments 200SZ, 200QZ, 200CZ, 100QZ and 100SZ, respectively ($R^2 = 0.26$). For liver zinc concentration, the 100OZ, 150OZ, and 150SZ treatments showed the highest values, and 100CZ and 200CZ the lowest. There were no sex differences, but the New Zealand White rabbits showed higher zinc deposition. Based on the results, the

following regression equation was obtained: $Y_{Zn} = 1.11 + 0.66x_1 + 0.55x_2 + 0.57x_3 + 0.56x_4 + 0.56x_5$ ($R^2 = 0.59$).

Key words: bioavailability, inorganic source, organic source, rabbit, zinc

NUTRITIONAL CONTRIBUTIONS OF COPROPHAGY FOR GROWING RABBITS RECEIVING DIETS WITH DIFFERENT LEVELS OF DRIED CITRUS PULP

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Thirty male New Zealand White rabbits were used for this experiment. Each was fitted with a wooden, Elizabethan type collar to evaluate the amount of dry matter and crude protein in the cecotrophes. The animals were divided in 5 treatments with 6 replications. The treatments were: basic diet (control) and the basic diet plus 10,20,30 or 40% citrus pulp (PCS). No effect of PCS was observed on the chemical composition of the cecotrophes. The amount of crude protein ingested through coprophagy was affected ($P < 0.05$) by inclusion of PCS in the diet. It was less for the control and the 10% treatment and greater for the 20%, 30% and 40% treatments.

Key words: rabbits, coprophagy, diet composition, dried citrus pulp

ACCEPTABILITY OF DIETS WITH INCLUSION OF *Leucaena leucocephala* AND *Arachis pintoi* IN RABBITS REARED FOR CONSUMPTION.

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For the purpose of evaluating the acceptability by farmed rabbits of diets in the form of meals which include foliage of *Leucaena Leucocephala* and *Arachis pintoi*, an experiment was carried out for 11 days in the Rabbit Farming Unit of the UNELLEZ Guanare (Edo. Portuguesa, Venezuela). 32 New Zealand x California rabbits were used with an average weight of 978 ± 111 grams, divided up among 8 galvanised cages. A free access feeding test was performed with 4 treatments: T_1 = inclusion of 30% *Leucaena* in the diet; T_2 = 40% *Leucaena*; T_3 = 30% groundnut forage and T_4 = 40% groundnut forage. The number of feeding attempts was recorded (NFA), considered as the number of times that the animal was in contact with the diets provided, through observations every ten minutes for a period of one hour. The daily consumption of diets was also measured. The data corresponding to NFA were analysed by Friedman's test and the averages of food consumption were compared with the Tukey test. Differences ($P < 0.05$) were found between treatments for NFA (5.79 ± 2.54 and 7.35 ± 2.99 versus 2.60 ± 2.38 and 3.12 ± 2.39 for T_1 and T_2 versus T_3 and T_4 respectively). Consumption of diets was greater ($P < 0.05$) for T_1 and T_2 (73.95 ± 0.96 and 73.26 ± 1.24 g/rabbit/day), than for T_3 and T_4 (58.16 ± 6.45 and 63.21 ± 4.25 g/rabbit/day). The diets were better accepted with levels of *Leucaena* at 30 and 40%.

DIETS FOR FARMED RABBITS WITH
INCREASING LEVELS OF *Leucaena*
leucocephala

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A 45 day experiment was carried out to evaluate the inclusion of increasing levels of leucaena forage (*Leucaena leucocephala*) in meal diets on the productive behaviour of farm rabbits. Fifty young New Zealand x California rabbits were used with an average weight of 709 ± 190 g., divided into 5 treatments, each repeated 5 times, with a completely random design. The treatments studied were: T1 = provision of basic diet; T2 = inclusion of 10% leucaena in diet; T3 = 20%, T4 = 30% and T5 = 40% leucaena. Variance analysis was applied and the Tukey test was used to compare the averages of the variables considered. The results indicated that the rabbits that had consumed a diet of 40% leucaena gained least weight ($P < 0.05$) (19.11; 18.89; 18.67; 18.67 and 9.89 grams/day for 0, 10, 20, 30 and 40% leucaena in the diet). Food consumption was least ($P < 0.05$) with the 40% leucaena diet (58.57; 58.82; 71.39; 74.36 and 52.67 g/rabbit/day for the treatments in the same order as above). While food conversion did not present any differences ($P < 0.05$) between treatments (3.06, 3.11; 3.82, 3.98 and 5.33 respectively). These results indicate that the inclusion of up to 30% leucaena forage in the diet did not cause reduction in growth or in food consumption. Consequently, it is advisable to evaluate the animal response and to consider the utilisation of this resource at levels of up to 30% in balanced diets for farm rabbits.

PARTIAL SUBSTITUTION OF THE
COMMERCIAL CONCENTRATE DIET
WITH *Gliricidia sepium* LEAF FLOUR IN
DIETS FOR GROWING RABBITS

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A study was conducted to study the effect of partial substitution of commercial concentrate diets (ACC) with *Gliricidia sepium* flour (HG) during the rabbit growing and fattening stages. A complete randomized design was used with four treatments and three replicates. There were five, 30 day old rabbits per experimental unit. The treatments were: T1 (100% ACC), T2 (85%ACC+ HGs ad libitum), T3 (70% ACC + HGs ad libitum), T4 (55% ACC + HGs ad libitum) and T5 (40% ACC + HGs ad libitum). Feed consumption and weight gain were measured weekly. Feed conversion and carcass yield were determined at the end of the trial. As the percentage of HGs increased, average feed consumption per week decreased ($P < 0.05$) as follows: 466 g/animal/week for T1, 468 g/animal/week for T2, 385 g/animal/week for T3, 291 g/animal/week for T4 and 246 g/animal/week for T5. The highest average weekly weight gain was with T2, (120.6 g/animal/week) and the lowest with T4 and T5 (72.0 and 73.1 g/animal/week, respectively) ($P < 0.05$). There was no effect on feed conversion. Carcass yield was highest ($P < 0.05$) for T1 and T2 and lowest for T3, T4 and T5 (58.16 and 57.18 vs 55.16, 55.73 and 55.03, respectively).

Key words: rabbit, feed, concentrate, Venezuela, *Gliricidia sepium*.

REVIEW OF RESEARCH INTO RABBIT FEEDS

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Data from 214 research experiments were examined comprising 938 tests on the feeding of rabbits published since 1971. The size of the sample is often insufficient. The fractions of protein, fibre, ether extract and digestible energy of the feeds were determined in 904, 707, 711 and 310 tests respectively. Consumption of feeds was less with fatty and non-granulated feeds; weight gain was less with non-granulated feeds, and feeds with protein and energy lower than 14% and 8.4 KJ/g respectively, and also when the ambient temperature was above 25° C.

EVOLUTION OF PERIRENAL FAT IN PRIMIPARA DOES FED WITH THREE HIGH ENERGY FEEDS

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The effects of three similar high-energy feeds were studied (F, with animal fat; O, with vegetable oil; S, with maize starch) on the thickness of perirenal fat (TPF) of 64 New Zealand x California female rabbits from the first fecundation until they gave birth to their second litters. During the first pregnancy, TPF rose until day 28, with the

greatest increase in the S group ($P < 0.05$) and then decreased until the litters were born. During lactation, milk production and growth of the litter were greater in groups F and O ($P < 0.05$) and a difference in the values of TPF was detected in the last week. After weaning, TPF reduced in the mothers 4 days after giving birth, while it rose in the mothers after weaning. They had 2.1 more young in their second litters ($P < 0.001$).

EVALUATION OF ENRICHED SUGAR-CANE MEALS IN NON-CONVENTIONAL DIETS FOR RABBITS

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A number of 180 rabbits were used to study growth during feeding with different types of sugar-cane formulas. The treatments were: commercial granulated feed and 5 diets of similar protein (16% PB) and energy (10.6 MJ) levels in the form of paste with molasses, and similar contents of rough fibre (10.6 – 12%), fibre sources being normal saccharine, saccharine with additive, normal saccharine-soy-wheat (66-4-30%, respectively), saccharine-soy-wheat and sugar-cane meal with an additive composed basically of honey and chicken manure. 4 variants were used in the prices of the raw materials of the meals, which covered a wide range of market situations. There were better daily weight gains in live weight with the granulated diet, with no differences between the sugar-cane and SSW diets. Conversions were in general high and were similar in order to daily weight gains, where the granulated was similar to the sugar-cane diet and the two SSW diets were no different to the S. The lowest cost diets were the sugar-cane and saccharine, with no difference between them. There were no significant differences

between the diets with or without additives. The granulated diet was the least cost-effective, while the best in this respect were the sugar-cane and the SSW, with no difference between them, and which were superior to the saccharine diets. It is feasible to include fermented or non-fermented sugar-cane at levels of up to 30% and SSW at levels up to 45% in rabbit feeds.

PRODUCTIVE PERFORMANCE OF NEW ZEALAND WHITE RABBITS TO DIFFERENT FEEDING LEVELS WITH SOYBEAN HAY (*Glycine max* L.) DURING THE POSTWEANING PERIOD

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Levels of 0, 5, 10, 15 and 20% of soybean hay were tested in rabbit feeding during the postweaning period. Thirty New Zealand White weanling rabbits (35 days of age) were utilized (15 males and 15 females). The experiment lasted 48 days, with one week for adaptation. Average daily gain (ADG), total feed intake (TFI), and feed conversion (FC) were analyzed. Independent variables were the level of soybean hay, sex of rabbit, the interaction level of soybean hay x sex, and initial rabbit weight as a covariable. Every rabbit within a cage was the experimental unit. A completely randomized design with a factorial arrangement 5x2 and three replications was utilized. Rabbits were weighed at the start of the experiment and subsequently every week. There were significant effects on ADG due to the level of soybean hay ($P<0.05$)

and sex of rabbit ($P<0.01$); the best level was 10% of soybean mixed with 90% of commercial concentrate, with an ADG of 32.6 g; female rabbits had better ADG averages than male rabbits (31.8 vs 29.0 g). There were significant effects on FI due to sex of rabbit ($P<0.05$) and initial rabbit weight ($P<0.01$); female rabbits had higher FI averages than male rabbits (4694.8 vs 4409.7 g); for every gram of initial rabbit weight the FI was increased by 44 g. It is concluded that is possible to include up to 10% of soybean hay in rabbit feeding during the postweaning period.

Key words: soybean hay, feeding, rabbits, postweaning.

PERFORMANCE OF RABBITS FED WITH DIETS CONTAINING DIFFERENT SOURCES OF VEGETABLE OIL

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A performance experiment was conducted after weaning, from 35 to 70 days of age, to evaluate the inclusion or not of 3% of canola oil, corn oil or soybean oil in diets to rabbits, fed since the lactation phase. 50 animals of each of four weaned rabbits group were employed, representing the mean weight of the group and allocated in a completely randomized design, with four treatments and 25 replications with two animals in each experimental unity. The live weight in the beginning of the experiment with 35 days of age, the live weight at 50 days of age and the weight gain in the period of 35 to 50 days were higher in the animals that received diets containing oil since the lactation phase. There was no difference, however to the feed intake and the feed

conversion. Considering the total period of the experiment, only the live weight with 70 days was higher in the rabbits fed with diets containing soybean oil. The carcass weight and dressing and the fat weight from inguinal, perirenal and dorsal regions were higher in the animals fed with diets containing oil. Based on the results and knowing the availability and the price of the oil sources and the production cost, it is recommended the soybean oil inclusion to the rabbits diets particularly until 50 days old.

PERFORMANCE OF RABBIT BROILERS
FED WITH
MULBERRY (*Morus alba*) AND SWEET
POTATO LEAVES (*Ipomea batatas*)

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Nine crossbred New Zealand Red kits were weaned and randomly distributed in two treatments to test two levels of mulberry forage; I) 3.18% of body weight of mulberry on a dry weight basis with 4 animals (3 females and 1 male) and II) 3.32% of body weight of mulberry on a dry weight basis with 5 animals (2 males and 3 females) and sweet potato greens as a ration supplement. There was no significant difference between the treatments for the parameters compared. Consumption (dry matter/animal/day), average daily gain (g/animal/day), and feed conversion (g dry matter/g increase of live weight) for treatments I and II were 87.16, 20.81, 16.30 and 82.33, 20.02, 19.64, respectively. It was concluded that use of mulberry in the diet at around 3% of body weight on a dry matter basis and the addition of sweet potato greens as supplement for the feed is an economical alternative for small rabbit growers.

PATHOLOGY

ELISA – DIAGNOSTIC SYSTEM
CREATED IN CUBA FOR *Toxoplasma*
gondii IN RABBITS.
STANDARDISATION AND
REGISTRATION.

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In this paper we present the methodology developed for the creation of a diagnostic system in which a soluble antigen of the RH *T. gondii* and the results obtained during standardisation, validation and registration of a Czech Indirect Immunofluorescence commercial system. In the analysis of the results, graphs and contingency charts were used, 93% sensitivity was achieved, 100% specificity and positive predictive value (PPV), 96.2% negative predictive value (NPV), 97.5% efficiency and 100% reproducibility. These results demonstrate that the diagnostic system developed is highly reliable and of the same level as international standards.

FIRST CUBAN EXPERIENCE IN
PRODUCTION AND CARE OF RABBITS
IN A CONTROLLED ENVIRONMENT
(FREE FROM SPECIFIC PATHOGENIC
GERMS).

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Nutrition plays a fundamental role in the production and care of rabbits, especially in the rearing of this species under controlled conditions (free from pathogenic micro-organisms) where the possible nutritional contribution by caecal microbial synthesis is minimised. The objective of the project is the nutritional evaluation of the proposed diets and alimentation methodology. Aseptic hysterectomies were performed on 5 White New Zealand does and 25 nestlings were obtained. These were fed manually with a chemically defined diet Chel3-94, formulated similarly to the composition of maternal milk and with a specially designed lactation methodology. After weaning, they received the complete diet with pelletised natural ingredients EMO 1402, fortified for steam sterilisation. The animals were administered orally an autochthonous gastro-intestinal micro-flora at 7 days old, composed of 4 microorganisms. For the first time in Cuba, the survival, growth and reproduction of SPF rabbits have been achieved in standard, flexible isolation compartments, with behaviour similar to conventional rabbits. This proves the nutritional suitability of the diets and of the lactation methodology utilised. This result places us in the forefront of the field of experimental nutrition and has permitted the development of fundamental work in different institutions of the country.

“ELISA” TEST FOR THE DETECTION OF
A Bordetella bronchiseptica IN RABBITS

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The work shows the results obtained in the standardisation of the ELISA Enzyme Immune System for the detection of *a Bordetella bronchiseptica* antibodies in laboratory rabbits. The work showed high specificity and sensitivity compared to another routine method of detection (culture and identification). The statistical analysis gave high repeatability and reliable control of hygiene and health quality of laboratory animals.

VACCINE AGAINST *Bordatella*
bronchiseptica IN RABBITS

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This work gives an evaluation of a whole-cell vaccine against *Bordatella bronchiseptica*. Its immunogenicity, innocuousness and protection for laboratory rabbits are evaluated, and also the results are given of a study of the isolation of the agent before and after vaccination. The clinical evaluation of the incidence of respiratory processes with the application of a massive vaccination is also given. All the results were included in a dossier submitted to the State Control Centre

of the IMV and its registration was approved.

DIGESTIVE AND RESPIRATORY ILLNESSES IN CONVENTIONAL RABBITS

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Digestive and respiratory illnesses from diverse causes are the most common pathologies in conventional rabbits. A six-year study was carried out on a total of 433 animals of different categories sent to the laboratory clinically healthy, ill or dead. Pneumonia was diagnosed in 120 animals (27.7%), enteritis in 134 (30.9%) and pneumo-enteritis in 49 (11.3%). The most affected categories were: farmed animals (digestive illnesses) and breeding animals (respiratory illnesses). The principle bacteria isolated in the respiratory tract were: *Escherichia coli*, *Pseudomonas aeruginosa*, *Bordetella bronchiseptica*, *Klebsiella spp*, *Staphylococcus aureus*. In the digestive tract the following were isolated: *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus spp* and *Enterobacter cloacae*. Intestinal coccidiosis was found to a lesser degree.

Key words: Digestive pathologies, respiratory pathologies.

EFFECTIVENESS OF THE APPLICATION OF DIFFERENT ANTIBIOTICS FOR RESPIRATORY ILLNESSES IN RABBITS

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Respiratory pathologies are still one of the principle causes of death in laboratory rabbits. This work compiles the data on the principle infectious agents of these processes and the effectiveness of some wide spectrum chemotherapeutic agents used in their treatment. The information was obtained in the course of one year at a rabbit production centre.

QUALITY CONTROL PROGRAMS IN THE PRODUCTION OF RABBITS TO BE USED AS LABORATORY ANIMALS

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The aim of this work is to describe the health controls and quality samplings, sampling frequency, size of the sample, test methods and the microbial agents to be monitored in order to determine the microbiological status of laboratory rabbits as part of the Quality Control Programs established for the obtaining and care of these experimental bio-models. Establishing the System of Veterinary Monitoring and the Quality Control Programs gives information on the biological condition of the animal,

reduces the risk of zoonosis, increases the accuracy, reliability and reproducibility of the data in experiments where rabbits are used; important considerations in Biomedicine and the Pharmaceutical Industry.

EPIZOOTIOLOGY OF A BREEDING COLONY IN A PRODUCTION UNIT OF LABORATORY RABBITS.

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To define the epizootiological conditions of a production colony of laboratory rabbits, the principle causes of morbidity and losses in the colony were determined; the chronological series of seasonal changes and tendencies in the indicators of morbidity and mortality in a period of 8 years were studied. After analysing all the health indicators with the Veterinary Monitoring System, it was observed that the zootechnical management established in the colony was appropriate for this species, that the indicators of morbidity by categories showed seasonal changes, with maximum peaks between March and April and lows between June and July, with significant differences between categories. Respiratory and cutaneous causes were of the highest incidence in this colony. The mortality indicator among reproductive animals showed a tendency to decrease throughout the 8 years, however in farm and lactating animals it was more stable. The mortality indicators in the colony studied were higher than those in other studies due to the type of installation and the climatic instability of Cuba.

PRODUCTION

OPPORTUNITIES FOR RABBIT RESEARCH AND HUMAN DEVELOPMENT IN THE WESTERN HEMISPHERE: A RABBIT REVOLUTION?

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Throughout the Western Hemisphere, opportunities exist to develop viable rabbit research programs that meet the unique needs of small-scale, limited-resource farmers. In this paper, basic problems of small-scale farmers are first briefly described, and, secondly, present examples are provided of alternative and innovative research programs that directly address these special needs. Rabbit scientists are further encouraged to elevate the stature of the rabbit as a significant "niche" livestock species to benefit humanity through the expansion of sustainable, small-scale rabbit farming and(or) development projects

PERSPECTIVES OF THE SYSTEMS OF BREEDING RABBIT IN RURAL ZONES OF THE TROPIC

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Problems related with rabbit keeping are considerable because many factors can impair production. The strategy to be

developed must take into consideration mainly the weak thermotolerance of rabbits, the need of producing directly at low cost the equipment and the alternative sheltering systems, the appropriate exploitation of local feeding resources and specific simple technologies as producing molasses blocks and crumbles, the adaptation of the management to the local situation, the evaluation of local genetic resources with the aim of selecting under the pressure of local limiting factors, the possibility of controlling diseases only by hygienic and technical means and the correct policy of monetary investing, aimed to develop many small rural units to assure, at least, a minimum of food security. Examples are shown and integrated production model are proposed.

BASIC PROGRAM FOR FARMING
RABBITS IN RURAL AREAS,
BUT WITH "MINIMUMS"

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The human population is increasing and resources are decreasing. We must cooperate in helping the poorest countries. The main aid should be directed towards achieving basic minimums, one of which is food, not going hungry; or even improving the diet by helping to increase consumption of animal protein. The only objective of this paper is to comment on a basic program to promote the breeding of rabbits to obtain meat and skins in rural areas of countries or regions suffering from poverty, as for example, in different parts of the Caribbean. This program is pretty basic but differs from others that imply "zero investment" and which experience has proved to be not very successful in the long run. It recognises that

certain "minimums" in investment and attention are necessary. The paper starts by emphasising the great advantages of rabbit breeding, which can be summed up in two basic points: 1) the fact that rabbits eat local fibrous products for which they do not compete with humans, and 2) their high productivity, since one female produces as much meat in a year as three sheep or four goats, meat high in proteins and with fatty acids. Twenty "family group" cages are suggested, made of galvanised bars, for 11 females, one male and the other 8 for breeding and consumption. (It is impossible for them to be reared on the ground or with bamboo cages, feeding troughs composed of old tins, etc, i.e. "without basic requirements"). And their handling is simple. With easy-to-remember rules. One of the basic aspects is replacement; the "2-2-10-10 program" being recommended. This says; "Every 2 months 2 young females of 10 weeks are chosen for every 10 adult females". They spend from 10 months to 1 year in production, on average. As regards feeding, the binomial protein/fibre is emphasised. From 14 to 17% protein. Maximum 17. From 13 to 16% fibre b. Minimum 13. Feeds ranging from balanced diets to dried grasses only. Always partly leguminous, and with leguminous sub-products (beans, chick peas, etc.), mention being made of *Leucaena*, Caribbean *Mimosa*, high in protein. A less toxic storage is proposed, with 1% ferrous chloride. The paper recommends, for ease of reproduction, that the operation be controlled by an NGO or by the State from a "centre", p.e. with 40 local females, colour of wild rabbit, and 5 white males, sending fathers and mothers to other reproductive centres. After 4 years, this could produce 9,000 breeding rabbits with a total production of 250,000 rabbits (275 metric tons of consumable meat). Or, alternatively, with an already established farm, with white breeds, crossing some females with local males, agouti or brown colour, sending "family groups" to other centres. The producers cross the mixed

breed dark coloured females with dark coloured mixed breed males in both cases. With good follow-up and organisation, this is the only system that can last. And give profits.

INDUSTRIALIZATION AND
GLOBALIZATION OF ANIMAL
AGRICULTURE: IMPLICATIONS FOR
RABBIT PRODUCTION

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Poultry production in the United States is now an industrial process. Less than 10 vertically integrated companies control poultry meat production. The swine industry is also rapidly becoming industrialized. Critics refer to industrial animal production as "factory farming". There is increasingly a societal backlash to what is perceived as factory farming. Major societal concerns are: (1) intensive animal production is inhumane and detrimental to animal welfare, (2) animal production is controlled by corporate interests rather than by family farmers, and is driven by profit motives rather than by ethical concerns for animal well-being, (3) intensive corporate animal production exploits workers, (4) modern animal production competes directly with grains used for human consumption, (5) diets containing animal products are unhealthy, causing degenerative diseases such as heart disease and cancer, (6) animal products are produced using antibiotics, hormones and other chemicals, resulting in food safety concerns, and (7) intensive animal production is harmful to the environment. In general, animal and poultry scientists are supportive of intensive, high-tech animal production, and have been responsible for much of the research, which has led to

technological innovations in animal agriculture. Intensive systems of animal production, largely a result of technological advances pioneered by animal and poultry scientists, have led to numerous animal welfare, food safety and environmental problems. Biotechnology has introduced further ethical issues, for example with cloning of animals. Animal scientists should be in the lead in addressing these problems and concerns. Rabbit production does not fit into the industrialized, globalized, corporate-controlled model, and may offer an alternative method of animal production more acceptable to the public.

EVOLUTION OF RABBIT PRODUCTION
IN SPAIN. CURRENT DATA RELATED TO
THE RAISING OF RABBITS IN SPAIN -
SITE OF CREATION OF THE IBERIAN
WILD RABBIT AND THE ONLY
DOMESTIC ONE

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Spain is one of the three major rabbit producers along with France and Italy. In 2001, it produced and consumed 130,000 tons of rabbit meat. These were all commercial white hybrids. There are three official production centers doing their own research plus additional private centers in the country. The largest farms have several thousand females, manage by bands and do the majority of AI with semen from private centers or their own bucks. The over-occupation by does and fryers is 120%. They use of complete commercial diets. Nearly 95% of the slaughter occurs at commercial slaughterhouses and numbers about 60,000 per week. Rabbits are slaughtered at 2 kg live weight. Rabbit meat is promoted as "the diet meat". The species

Oryctolagus cuniculus - the only domestic species - was created between 150,000 and 50,000 years ago on the Iberian Peninsula. This has been proved by genome tests. It was the place of early domestication for the Roman legions. Romans made the first historic citations. The consumption of rabbit meat was incremental to a commercial level, from the rural or backyard levels around the world. We hope this reference to our production and consumption increases the creation of new rabbit farms and the increase of meat consumption.

SYSTEMS OF RABBIT PRODUCTION IN TACHIRA STATE, VENEZUELA

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The main objective of this study was to determine the systems of rabbit production with major emphasis on technical-social-economic side of rabbit farms in Tachira, Venezuela. A questionnaire was designed to collect information on production systems, feeding, sanitation, reproduction, and social and economic factors for production units of 10 or more breeding does. The questionnaire was administered at 18 rabbit production units. This was equivalent to 72% of rabbit producers. Of the existing farms, 78% are classified as semi-intensive, 40% of the labor is provided by family members and does not exceed on contracted labor. The number of weaned kits per litter is 5 to 7. The mortality rate in adults is 1 to 5%, post weaning 1 to 10% and pre-weaning 10 to 25%. The number of births/per doe/year is 4 to 5. The fattening period was 60 to 90 days and weaning age was 30 to 35 days. Production

is sold at the farm site (61.11%) or at the nearest city (38.84%). It can be concluded that the differences in rabbit production among the rabbit producers in Tachira are due to management, installations, and production levels. The production can be classified as fundamental from the technical point of view. It can also be concluded that this species is a feasible alternative for meat production. Therefore, it should be considered for future planning of regional development.

MARKETING OF RABBIT MEAT IN RESTAURANTS IN TEXCOCO, MEXICO

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A study was done by a census for the municipality's restaurants to find the number of restaurants in the municipality of Texcoco that include rabbit meat in their menus, cooking methods, prices, amount of meat marketed through restaurants as well as the presentation of rabbit, buying price according to presentation and causes why some restaurants don't include it in their menus. A questionnaire was given to the owner or manager of each restaurant registered with the Texcoco Chamber of Commerce Division of Service and Tourism. Half of the restaurants include rabbit meat in their menu. These restaurants offer an extensive variety of dishes but the most popular are adobo, mixiote, broiled or grilled. The price for those dishes in American Dollars ranged between \$3.00 ±0.40 to \$5.40 ±1.70. These restaurants marketed 1230 rabbits weekly. This is equivalent to 1,476 kg/month (17,712 kg/year). Commercial farms provide 54% of the meat is provided by commercial farms, 16% comes from wholesalers and 15% from home growers.

Most restaurants prefer the rabbit slaughter (83%) although 17% prefer it alive (17%). Of the slaughtered rabbits, 90% was fresh and 10% was refrigerated. The reason why restaurants do not include rabbit meat in their menu is because of lack of availability (60%), lack of demand from consumers(10%) and high price(10%).

PRODUCTION OF RABBIT MEAT AS AN
ALTERNATIVE IN SEMIDESERT REGION
OF QUERETARO
(QUERETARO,MEXICO): AN
INDIGENOUS, MARGINALIZED REGION
WITH LOW POTENTIAL FOR LAND
AND CATTLE PRODUCTION

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The municipality of Toliman (Queretaro State, Mexico) is located in the so-called semi-desert queretano, a region with scarce natural resources, low economic resources, marginal discrimination, and child malnutrition. Rabbit production has been an alternative for 43 women and their families in four towns of the municipality of Toliman under a system of semi-technical and rustic infrastructure to improve their diet and have additional income by selling rabbit meat and crafts made with rabbit fur. Initially, the main target of the project was production of rabbit meat for their own consumption. They then found that with good management within the UPR standards (Rural Production Units), production surpassed the expected outcome, The producers mentality changed and they increased meat production for sale to the public. This objective was reached with interaction with technicians who coordinate and look for subsidies from government institutions for programs that

focus on improving the quality of life of the rural families - in this case, women. There are four groups, one in each community and each group has formed a cooperative, and each one has become a rabbit growing association. Each producer works independently in her UPR, but they work in groups to learn rabbit meat processing, for marketing, for acquisition of supplies, sharing of resources and promotion of products. The 43 women and their families consume 210 g of meat/week on average and have an income of \$13.37/ week for sale of meat and leather crafts.

REPRODUCTION

CONTROL OF REPRODUCTION IN FEMALE RABBITS

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The search for alternative sources of animal protein is important, especially if we consider the rapid growth in world population and what this implies. The consumption of rabbit meat in developing countries has increased considerably in recent years, as has the proliferation of rabbit farms. For this reason, rabbit farmers must keep up to date with and apply technological advances to guarantee high productivity and profitability. To improve productivity, production costs must be kept to a minimum and profits maximised, for which special genetic and handling techniques are required. The principle objective of this paper is to make known some advances in different methods of control of reproduction in rabbits, and their effects on reproductive-productive

behaviour in intensive farming of rabbits for consumption.

USE OF CONTROLLED LACTATION IN RABBITS. EVALUATION OF THE REPRODUCTIVE INDICATORS

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The experiment was carried out at the Granja Central of MININT N° 23 in Jagüey Grande, Matanzas Province, from June to September 2000. 240 Chinchilla and Semigigante Blanco does were used between their second and fourth litters and average weight over 4 kilos. The animals were randomly divided into two equal groups according to breed. Group 1 consisted of 60 females of each breed. Lactation was controlled by allowing access to the nest once in the morning every 24 hours for 11 consecutive days. Then, after lactation, the external genitals were examined and they were taken to be paired with bucks. The non-receptive does were paired with males again at intervals of 48 – 72 hours. Group 2 (Control) consisted of the same number of animals and breeds and followed the traditional system except that the females were paired with males for the first time 11 days post-partum. The non-receptive females were paired again after 30 – 60 days. Receptivity at 11 days was analysed, percentage of births, interval between litters, number of live young at birth and at weaning. It was considered that this method considerably improved the reproductive indicators, increasing by 23.1% the number of litters per doe.

USE OF CONTROLLED LACTATION IN RABBITS. STUDY OF PRODUCTIVE INDICATORS

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USE OF CONTROLLED LACTATION IN
RABBITS.
FINANCIAL EVALUATION.

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INFLUENCE OF NURSING METHOD ON
THE PERFORMANCE OF RABBIT DOES

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To study the effect of nursing method on reproductive performance, 232 rabbit does were divided into four experimental groups: FF: free nursing from kindling to weaning at 35 days of age; FC: free nursing from day 0 to 7 and once-a-day nursing from day 8 to 17; CF: once-a-day nursing from day 0 to 7 and free nursing from day 8 to 17; CC: once-a-day nursing from day 0 to 17. From day 17 of lactation to the time of weaning free nursing was used in all groups. During controlled nursing the does could visit the nest box between 8 and 9 a.m. every day. Insemination was performed on day 10 *post partum*, within 15 minutes after nursing. The results of three consecutive kindlings were evaluated. The nursing method did not influence sexual receptivity at the time of insemination, but in Group CF sexual receptivity was 10% lower (57, 53, 47 and 59% for Groups FF, FC, CF and CC, respectively). As compared to FF does, in the other groups both the pregnancy rate (56% vs. 69, 62 and 58%, respectively) and the kindling rate (43% vs. 58, 49 and 45%, respectively) improved slightly but the increase was not statistically significant. No significant differences were found between the groups in total litter size, live-born litter

size and litter size at weaning. The only statistically significant difference was found between Group FF and Group FC in litter size at 21 days of age. Rabbits of Group FC showed the best performance in the experiment. From the results it can be concluded that change-over from free to once-a-day nursing before insemination can be a successful biostimulation method for improving reproductive performance.

EVALUATION OF A COMPLETE DIET
AND OF TWO SYSTEMS OF
REPRODUCTION IN MIXED-BREED
RABBITS.

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The aim of this work was to evaluate the use of a complete diet in breeding does and an intensive system of reproduction. 80 females and 20 males (F1) were used, all animals that had not been previously utilised for reproduction. These were divided into 4 groups of 20 does and 5 bucks per group. The treatments tested were: 1) Control Diet + System, traditional reproduction (pairing of does 15 days post-partum / weaning of young at 42 days). 2) Control Diet + Intensive Reproduction (pairing post-partum and weaning of young at 21 days). 3) Experimental Diet + Traditional System of Reproduction. 4) Experimental Diet + Intensive Reproduction. The results show that the indicators live births, live weight, weight gain, mortality and morbidity of the young at birth and during lactation were significantly superior in animals that had consumed the experimental diet and had been subject to the intensive reproduction system. Similar behaviour was observed in the zootechnical indicators for the mothers (mothers' weight at birth of litter, fertility).

PRELIMINARY DIAGNOSIS OF THE
FERTILITY OF MALE BREEDING
RABBITS OF THE ACPA CENTRE AT
SANCTI SPIRITUS

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The ejaculation of male rabbits of different breeds in the production unit at the provincial town of Sancti-Spiritus was observed with the objective of making an early assessment of their reproductive behaviour. An artificial vagina was designed and made (VAF 1 and VAF 2) that allowed satisfactory extraction of semen. Macroscopic (volume, density, colour, pH, presence of gel) and microscopic (mass and individual motility, concentration) analyses were performed and showed that the fertility behaviour of the young animals studied were different for each breed; the Brown Cuban needed a longer time for sexual maturity than the other breeds. Also, animals that became sterile in the hot season did not show signs of recuperation for the duration of the rest of the investigation (cold season). The data ratified the hypothesis that an early assessment of the fertility of males reduced the risk of wasting time in reproduction.

REPRODUCTIVE INDICES IN FEMALE
RABBITS FED WITH FEEDS RICH IN
ALFALFA

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Female white New Zealand x California rabbits were fed ad lib in the course of 5 reproductive cycles with three feeds: A) 96% alfalfa, 8.7 MJ ED and 108g PD; AF) 92% alfalfa, 5% added fat, 9.6 MJ DE and 105g DP; control C) similar to commercial feed, 12.0 MJ DE and 122g DP (data refer to kilo of dry material). In Experiment 1, 79 females (342 litters) were kept in a traditional enclosure, inseminated 4 days post-partum,

standard litters of 8 nestlings and weaned at 28 days. The litter number significantly affected the variables analysed, which were worst in the first cycle. The response of the AF group of females was in general between A and C. Median results for the feeds A, AF and C were respectively: 2.3, 2.7 and 1.8 inseminations per gestation ($P<0.001$); 3.7, 4.0 and 4.5 kilos weight of litter at weaning ($P<0.001$). In Experiment 2, 64 females (294 litters) were kept in a conditioned chamber at a temperature of 30° C, inseminated at 10 days post-partum, standard litters of 6 nestlings and weaned at 35 days. The litter number significantly affected the variables analysed, which were worst in the first cycle. The response of the AF group of females was in general between that of groups A and C. Median results for feeds A, AF and C were respectively: 2.6, 2.5 and 1.7 inseminations per gestation ($P<0.001$); 3.7, 4.3 and 4.4 kilos weight of litters at weaning ($P<0.001$).

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