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EVALUATING THE RESPONSE TO  
SELECTION IN MEAT RABBIT  
PROGRAMMES

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Results of two experiments of selection for litter size or uterine capacity, involving three lines of rabbits, are used to compare different methods of evaluation of the response to selection. Direct methods, based in the study of the differences between one selected and a control population, are compared to indirect methods, based on solutions of mixed models or on bayesian inference. It is checked that in some cases the indirect methods lead to different conclusions than the direct, being the general applicability of the former questioned. On the other hand all the experiments have had response in litter size, but the prenatal component responsible seems dependent on the

selected line. One line has got the response by improving the ovulation rate, other through the improvement of the foetal survival and the third modifying slightly the ovulation rate and more importantly the embryo survival.

**Key words:** Selection program, meat rabbit.

DEVELOPMENT AND CONSERVATION  
OF LOCAL RABBIT GENETIC  
RESOURCES IN EGYPT

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This paper discusses the importance of biodiversity in animal genetic resources with a special reference to rabbits in Egypt. Egyptian literature on the rabbit genetics is rich with results of crossbreeding experiments mainly with exotic breeds but rather poor in the identification and characterization of local populations and sub-populations. Two breeds were

reportedly created in Egypt, the Giza White and the Baladi with three strains, Red, White and Black, and two more are identified, the Sinai Gabali and Matrouh Gabali. The Giza White was developed through selection for albino color, heavier animals and large litter size among native rabbits with accompanying intensive inbreeding. Giza White has become extinct. The Baladi was developed by crossing native female to Giant Flander bucks and backcrossing to the exotic for many generations and separating the three colors. Flocks of Baladi Red and Baladi White are currently maintained at the Ministry of Agriculture Experimental stations. These are institutional flocks from the Sinai Gabali, but none from the Matrouh Gabali. Sinai Gabali is also living in feral state in Sinai. The importance of further characterization, morphologically, phenotypically and molecularly, of local breeds and the identification of other rabbit populations and subpopulations was highlighted.

**Key words:** Genetic resources, rabbits, Baladi, Giza White, Sinai Gabali, Matrouh Gabali, biodiversity, conservation.

MAJOR THEMES OF THE POST  
GENOME ERA (GENOMICS,  
PROTEOMICS AND BIOINFORMATICS)  
AND RABBIT INFORMATICS  
RESOURCES

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The discovery of the DNA structure and the genetic code triggered a revolution in which there was a determination to sequence the genome of living beings and

to decipher the code of life in the hope that this might enable to understand its secrets. The early beginning projects were established to sequence genes. Now they are aimed at sequencing complete genomes. But, since the beginning of the first sequencing project, two entities showed a clear distinction. These were the DNA and the protein and new fields cropped that were more specific to these two elements. For the DNA there was the genomic science, which deals mainly with DNA, while for the protein proteomics showed itself as an independent field specific to protein research. These initiatives gave rise to huge amounts of molecular biology data and massive amounts of sequencing information that needed to be submitted in Genbank as repository. This information overload necessitated the presence of a media through which scientists can paste, retrieve and record it. This medium was the Internet, which became the major source of scientific information. This in turn required the presence of a reliable way to handle, organize and analyze these data. Bioinformatics, as a newly interdisciplinary science, emerged as an interface between biology that deals with biological data using computer science and information technology, to transform these data after organization and analysis into useful information and knowledge. Bioinformatics is a discipline in molecular biology that covers a wide range of subject areas from genomics, proteomics (protean research) to molecular phylogeny.

**Key words:** Genomics, proteomics, computational biology, bioinformatics, rabbit genome.

## GENETIC MARKERS IN ANIMAL AND RABBIT BREEDING

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Identification of genetic marker, genetic markers identification technologies, approaches for genetic marker: 1. Antigenic (Blood group and histocompatibility antigens). 2. Allozyme and 3. DNA markers, such as: restriction fragment length polymorphisms (RFLP), microsatellite (STR), minisatellites (VNTR) and single nucleotide polymorphic markers (SNP), marker assisted selection (MAS), marker assisted introgression (MAI), markers and the gene map and their possible application in terms of selection breeding program of rabbit breeds and farm animals, are reviewed.

**Key words:** Genetic markers, animals, rabbit breeding.

## IMPACTS OF HOUSING CONDITIONS ON RABBITS PERFORMANCE IN EGYPT

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Housing of livestock is originally motivated to reduce any climatic adverse effects on production and to facilitate management. Therefore, this article deals primarily with the functional relationships between rabbits performance and housing conditions under Egyptian local environment. Recent (original battery) system and conventional (traditional cages,

modified units, hut and underground) systems under Egyptian conditions are presented and discussed. The models of housing are evaluated to decide which is more efficient for the welfare of rabbits; does, bucks and kits, throughout seasonal environmental fluctuations. Also, to decide whether these models are satisfactory in their current conditions or whether they should be remodeled according to local conditions. The micro and macro environmental conditions are discussed. The physical properties of building materials and thermal heat exchange are determined. Both physiological reactions and biological performance were determined as accurate indicators of rabbits welfare. Conclusions and recommendations suggested by several workers are presented.

**Key words :** Housing, micro and macro-environment, physiological reactions, biological performance.

## VISIBILITY STUDIES OF RABBIT PROJECTS

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Raising rabbits can be profitable as a small farm or as a commercial large scale, if good management is practiced and attention is paid to details. Rabbits have the greatest reproductive potential of any farm livestock. A doe can produce up to 18 times her own weight in edible meat in a year's time. In addition, rabbit meat is high in protein (22% protein) low in fat (6-8% fat) and cholesterol (25 mg/100g) and easy to digest. There are some points must be considered for rabbit

project to be successful.

**Key words:** Visibility studies, rabbit projects.

## GENETICS AND BREEDING

### GENETIC AND ENVIRONMENTAL TRENDS FOR POST-WEANING BODY WEIGHTS IN NEW ZEALAND WHITE AND Z-LINE RABBITS USING THE ANIMAL MODEL APPROACH

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Genetic and environmental trends were evaluated for post-weaning body weights of 20677 weaned rabbits of New Zealand White (NZW) and Z-line born between 1982 and 1996 from 1212 sires and 3168 dams. Multi-trait animal model was used for such evaluation taking into account body weights at 8 and 12 weeks of age. Heritability estimates for the two body weights in NZW were higher than those in Z-line; being 0.34 and 0.30 in NZW and 0.10 and 0.25 in Z-line at 8 and 12 weeks of age, respectively. Common litter effects were higher in Z-line (averaged 37.65%) than those in NZW (averaged 29.95%). All correlations between the two body weights were moderate or

high; being 0.73 and 0.69 for genetic correlations, 0.60 and 0.64 for phenotypic correlations, 0.49 and 0.64 for common-litter correlations and 0.45 and 0.68 for environmental correlations in NZW and Z-line rabbits, respectively. The ranges in predicted breeding values (PBV) for body weights at 8 and 12 weeks of age were 572 and 639 gram in NZW, while they were 216 and 449 gram in Z-line, respectively; i.e. wide variations in PBV of body weights between the two strains were in favor of Z-line rabbits. The accuracies ( $r_{aa}$ ) of minimum

and maximum estimates of PBV were mostly higher in NZW than those in Z-line for the two weights; ranging from 0.48 to 0.73 in NZW and 0.38 to 0.62 in Z-line. Genetic trends indicate that PBV were mostly positive in NZW and negative in Z-line over the whole period of the study. In NZW rabbits, the trend indicates that the plateau for the breeding values reached soon at the beginning years, while in Z-line the rates of change in breeding values were very low during the five years of the study. Plots of year-season trends indicate that environmental effects (i.e. seasonal-annual variations) play a large role in improvement of the two body weights in both lines.

**Key words:** Body weights, Animal model approach, heritability, correlations, breeding values, genetic trend.

GENETIC EVALUATION OF MILK PRODUCTION AND LITTER WEIGHT TRAITS IN GABALI, NEW ZEALAND WHITE RABBITS AND THEIR CROSSES IN A NEWLY RECLAIMED AREA OF EGYPT

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A crossbreeding study was carried out in Maryout Experimental Station, Desert Research Center using Gabali (Gab) as a local breed and New Zealand White (NZW) rabbits as an exotic one in addition to their two reciprocal crosses to study direct heterosis, maternal additive and direct additive effects in addition to some non-genetic factors on milk production and litter weight traits up to weaning. Means of total milk production from kindling up to 21 days and up to weaning at 35 days were 1330.92±23.29 and 1941.93±33.67 gm, respectively. Litter milk efficiency up to 21 and 35 days were 0.85 and 1.02, respectively. Season of kindling contributed significantly to litter milk efficiency traits. Summer kindling does tended to produce the heaviest milk production litter weight at different ages. Milk production and litter weight traits were not affected significantly by mating group. Crossbreeding between NZW and Gab rabbits though non-significant resulted in persistent heterotic effects on milk and litter weight traits studied. Most of doe milk production and litter weight traits were in favour of litters damed by local Gab does as compared to those damed by NZW ones. Direct additive effect on milk production traits was in favour of the crossbred litters sired by NZW bucks.

**Key words:** Milk production, litter weight,

Heterotic effect, direct additive effect, maternal additive effect.

PUREBRED DIFFERENCES AND SOME CROSSBREEDING EFFECTS (DIRECT HETEROSIS, DIRECT ADDITIVE AND MATERNAL ADDITIVE) ON CARCASS TRAITS USING GABALI RABBITS AND THEIR F1 CROSSES WITH CALIFORNIANS IN EGYPT

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A crossbreeding experiment was carried out in Maryout Station to study the genetic and non-genetic effects on different carcass traits in Gabali and Californian rabbits as well as their crosses. Linear mixed model was adopted to study the effects of breed group, year of birth, season of birth, sex and parity on these traits. Genetic model effects (direct heterosis, maternal additive and direct additive) were estimated. Breed group differences were significant at 12 weeks of age on most carcass traits. Purebred differences were in favour of Gabali rabbits and significant for most carcass traits at 12 and 16 weeks of age. Estimates of direct heterosis for most traits under consideration were positive, significant ( $P<0.05$ ,  $P<0.01$ ) and ranged from 0.60 to 4.25% at 12 weeks while from 0.25 to 19.50% at 16 weeks. These results indicated that crossbreeding between Californian and Gabali rabbits was associated with some improvement in carcass performance of the crossbred rabbits. Maternal additive effect was mostly in favour of Gabali-damed rabbits for carcass performance at 12 and 16 weeks of age. Direct additive effect at 12 and 16 weeks was significant ( $P<0.05$ ,  $P<0.01$  or  $P<0.001$ ) on most carcass traits.

**Key words:** Crossbreeding, carcass traits, direct heterosis, maternal additive, direct additive.

BEST LINEAR UNBIASED PREDICTION (BLUP) ON SOME LITTER TRAITS AND MUSCULARITY RATE OF NEW ZEALAND WHITE RABBITS UNDER EGYPTIAN CONDITIONS

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Data of some litter traits (litter size at birth, litter size at weaning and litter weight at weaning) as well as muscularity rate of 150 litters belongs to New Zealand White (NZW) rabbits from 23 sires were analyzed using Restricted Maximum Likelihood (REML) under Mixed Model Equations. Best Linear Unbiased Estimates (BLUE) included the effects of parity, month of kindling along with unrelated 23 sires as a random effect. Overall best linear unbiased estimates (BLUE) for litter size at birth (LSB), litter size at weaning (LSW), litter weight at weaning (LWW) and muscularity rate (MSCR) were 6.8, 5.17, 2622.1 gm and 42.02 % respectively. Ranges of transmitting ability (TA) estimates of NZW rabbits considering LSB; LSW; LWW and MSCR were -0.25 to 0.22; -0.36 to 0.24; -172.31 to 128.93 and -2.84 to 4.79 respectively. The percentages of sires having positive TA were 60.87; 52.17; 52.17 and 52.17 respectively. However, the number of sires having positive TA records exceeded 50% at all traits. The Product moment correlation coefficient concerning sire transmitting ability and the Spearman correlation coefficient concerning ranks of sire transmitting ability ranged generally between low to intermediate and

significance were detected ( $P < 0.05$ ) for litter size at weaning and litter weight at weaning.

**Key words:** Rabbits, litter traits, parity, transmitting ability.

MILK YIELD AND COMPONENTS AND MILK TO LITTER-GAIN CONVERSION RATIO IN CROSSING OF SAUDI GABALI RABBITS WITH V-LINE

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Six genetic groups of **V**, **G**,  $\frac{1}{2}\mathbf{V}\frac{1}{2}\mathbf{G}$ ,  $\frac{1}{2}\mathbf{G}\frac{1}{2}\mathbf{V}$ ,  $\frac{3}{4}\mathbf{V}\frac{1}{4}\mathbf{G}$  and  $\frac{3}{4}\mathbf{G}\frac{1}{4}\mathbf{V}$  were produced from a crossbreeding project involving Spanish breed called **V**-line (**V**) and Saudi Gabali (**G**) rabbits. For the first two generations of this project, milk yield at intervals of 0-7, 7-21, 21-28 days, and 0-28 days and milk components at 14 days of lactation (fat, protein, lactose, ash, total solids and total energy of milk), and milk to litter-gain conversion ratio (0-28 days) were evaluated for 624 litters of 200 does fathered by 48 sires and mothered by 134 dams. Seasonal variations, parity order and litter-size at birth affecting these traits were also investigated. Differences between the two generations in most milk yields and components were limited. Milk to litter-gain conversion ratio during the whole suckling period were significantly ( $P < 0.01$ ) in favour of the second generation (1.288 vs. 1.555 kg of milk per kg of litter gain). In most cases, genetic group of  $\frac{1}{2}\mathbf{G}\frac{1}{2}\mathbf{V}$  gave higher milk yield and better conversion ratio of milk to litter-gain. No clear differences were notified for fat, lactose and energy of milk in the six genetic groups. The highest percentages of protein and total solids were recorded by

$\frac{1}{2}V\frac{1}{2}G$  group (13.9 and 32.4%), while the least values were recorded by  $\frac{3}{4}V\frac{1}{4}G$  group (11.7 and 29.2%). The highest ash content in milk was in  $\frac{3}{4}V\frac{1}{4}G$  group (2.33%), while the least group in ash was  $\frac{3}{4}G\frac{1}{4}V$  (2.03%).  $\frac{1}{2}G\frac{1}{2}V$  was the best genetic group in milk to litter-gain conversion ratio (1.234 kg/kg), while VV was the least group (1.946 kg/kg). No significant differences were found between the five parties regarding milk yield, fat, protein, ash, total solids, and energy of milk. The milk of the 4<sup>th</sup> parity (peak of lactation) had the richest component (14.5, 15.1, 1.95, 2.41, 32.9 g/100g and 934 kJ/100g for fat, protein, lactose, ash, total solids and energy, respectively). The highest total milk yield was recorded in autumn (4194 g), whereas the lowest value was recorded in spring (3284 g). Differences between seasons in fat, protein, lactose, total solids, and energy of milk were little, while ash content was significantly affected ( $P<0.05$ ) by season. The highest total milk yield was observed for litter-size class of ten (4774 g), whereas the lowest value was recorded for litter-size class of two (2041 g). Differences in fat, protein, lactose, ash, total solids and energy of milk for different litter-size classes were limited.

**Key words:** Saudi rabbits, crossbreeding, milk yield and components, milk conversion ratio.

#### SEMEN CHARACTERISTICS OF BUCKS IN CROSSBREEDING PROJECT INVOLVING SAUDI GABALI WITH V-LINE RABBITS IN SAUDI ARABIA

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Semen characteristics of bucks were

evaluated for five genetic groups produced from a crossbreeding project involving Spanish breed called V-line (V) and Saudi Gabali (G) rabbits. For the first two generations of this project, volume of ejaculate, sperms abnormalities, living sperms, dead sperms, sperms concentration, motility of sperms and libido of bucks of these genetic groups were evaluated for 195 ejaculate given by 74 bucks. Seasonal variations in semen ejaculated by bucks and effect of litter size in which the buck was weaned were also investigated. Sperms concentration (being 525, 543 and 488 sperm in 0, 1<sup>st</sup> and 2<sup>nd</sup> generation, respectively) and motility of sperms (being 47.4, 68.1 and 79.9 % in 0, 1<sup>st</sup> and 2<sup>nd</sup> generation, respectively) increased or improved from the parental generation to the two subsequent generations. Significant improvements in semen parameters of crossbred bucks than in purebred ones were recorded in terms of sperms concentration ( $P<0.01$ ) and percentages of motile sperms ( $P<0.001$ ), abnormal sperms ( $P<0.001$ ) and dead sperms ( $P<0.05$ ). Most semen parameters of V-line bucks were better than in G rabbits. Lower volume of ejaculate (0.56 ml) in addition with lower motility rate of sperms (50.6%) was noticed in the Gabali rabbits than in the other genetic groups. Autumn and winter recorded the best semen parameters in terms of sperm concentration, motility of sperms, abnormal sperms and libido relative to spring and summer. The estimates during autumn, winter, spring and summer were 537, 564, 405 and 437 for sperms concentration (sperm multiplied by  $10^6$  per ml), 72.0, 68.5, 61.6 and 58.4% for motility of sperms, 7.6, 5.3, 9.6 and 10.2% for abnormal sperms and 4.03, 3.38, 3.51 and 3.04 for libido. Moderate litter size of 6 or 7 born by the doe gave the lowest abnormality rate of sperms in the semen of bucks (about 7.8%) and the largest volume of ejaculate (about 0.68 ml) associated with the highest sperm concentration (about 522 sperm multiplied by  $10^6$  per ml), sperm motility (about 78%), living sperms (about 91.5%) and libido (about 4%).

**Key words:** Gabali Saudi rabbits, crossbreeding, semen parameters, genetic groups, seasonal variation.

## PHYSIOLOGY AND REPRODUCTION

### EFFECT OF VITAMIN E AND /OR SELENIUM INJECTION ON: 2. GROWTH PERFORMANCE AND SOME BLOOD CONSTITUENTS OF NEW ZEALAND WHITE AND BALADI BLACK RABBITS WEANED DURING SUMMER SEASON OF MIDDLE EGYPT

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The present investigation was carried out at Seds Research Station, Beni-Suef Governorate (middle Egypt), belonging to Animal production Research Institute during summer, 1999, to study the effect of vitamin E and/or selenium injection on rectal temperature (RT), respiration rate (RR) blood hemoglobin (Hb), blood hematocrit % (Ht), plasma vitamin E (Vit. E) and selenium (Se) levels, growth performance, performance index (PI %) and some blood constituents of male and female New Zealand White (NZW) and Baladi Black (BB) rabbits weaned and reared during summer season of middle Egypt from 6-16 weeks of age. A total of 112 males (44 BB and 68 NZW) and 100 females (40 BB and 60 NZW) were assigned at 6 weeks of age to four equal groups, maintained under normal nutritional status. The first group was considered as

control and injected with saline solution. The second group was injected intramuscularly with 0.1 mg Se/ kg body weight/ week as sodium selenite. The third group was injected subcutaneously with 75 IU Vit. E/ head/ week as alpha-tocopherol. The fourth group was injected with Vit E+Se at the same doses of the previous two groups. At 16 weeks of age, three NZW males of each group were scarified for carcass traits. The results obtained showed that rabbit injected with Vit E+Se had higher ( $P < 0.05$  or  $P < 0.01$ ) RT, RR, Hb and Ht %. The Vit. E+Se injected rabbits attained the heaviest ( $P < 0.05$ ) final body weight, daily gain, PI %, best feed conversion and reduced ( $P < 0.01$ ) mortality %. Carcass traits values were improved ( $P < 0.05$ ) by the Vit E+Se injection. Blood plasma Vit. E level was higher ( $P < 0.001$ ) in Vit E and Vit E+Se groups. Injection with Se increased ( $P < 0.05$ ) plasma Se level in rabbits treated with Se and Vit E+Se. The Vit E+Se injection increased ( $P < 0.01$ ) plasma total protein and albumin, decreased ( $P < 0.01$ ) globulin and cholesterol, ALT and AST, increased ( $P < 0.05$  or  $P < 0.01$ ) plasma glucose, P and T<sub>3</sub> hormone. The NZW rabbits had higher ( $P < 0.05$ ) RT and RR, final body weight, daily gain and PI % than BB rabbits. Breeds affected ( $P < 0.05$ ) plasma Vit. E concentration, globulin and glucose levels, and affected ( $P < 0.01$ ) plasma cholesterol level. The female rabbits maintained nonsignificantly higher RT, RR, Hb, Ht %, final body weight, PI % and higher ( $P < 0.05$ ) plasma albumin, glucose and cholesterol levels than the male rabbits. Plasma total protein, albumin and globulin increased ( $P < 0.01$ ) and decreased ( $P < 0.05$ ) glucose, cholesterol, Ca and T<sub>3</sub> hormone by age progress. It could be concluded that Vit. E+Se injection for growing rabbits weaned during summer season improved feed conversion, growth performance and carcass traits.

**Key words:** Rabbit, growth, Se, Vit. E, carcass.

EFFECT OF VITAMIN E AND /OR  
SELENIUM INJECTION ON PUBERTY,  
MATURITY, SOME ANATOMICAL AND  
HISTOPATHOLOGICAL PARAMETERS  
OF MALE GENITALIA OF RABBITS  
WEANED DURING SUMMER SEASON  
OF MIDDLE EGYPT

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A total of 98 male (36 Baladi Black, BB, and 62 New Zealand White, NZW) rabbits in Seds Research Station, Beni-Suef Governorate (Middle Egypt), belonging to Animal production Research Institute weaned during summer, 1999, were assigned at 6 weeks of age to four groups. The first group (8 BB and 14 NZW) was injected with saline solution as control. The second group (9 BB and 16 NZW) was injected intramuscularly with 0.1 mg selenium/ kg body weight/ week (Se) as sodium selenite. The third group (10 BB and 16 NZW) was injected subcutaneously with 75 IU vitamin E/ head/ week as alpha tocopherol acetate (Vit. E) and at 4 months of age the dose increased to 100 IU Vitamin E/ head/ week. The fourth group (9 BB and 16 NZW) was injected with Vit. E+Se at the same doses of the previous groups. At three months of age blood samples were collected biweekly from marginal ear vein in a heparinized tubes to determine plasma testosterone hormone, Vit. E and Se levels. Semen was collected weekly by means of an artificial vagina to determine age at first ejaculate containing spermatozoa (puberty) and some physical characteristics of semen. At age of 4.0, 5.5 and 7 months, three NZW male rabbits from each group were slaughtered to study some anatomical and histopathological parameters

of male genitalia. Results indicated that Vit E alone or Vit E+Se injection increased ( $P < 0.01$ ) Vit. E level in peripheral plasma. Selenium injection increased ( $P < 0.01$ ) plasma Se concentration of rabbit treated with Se and Vit E+Se groups. Rabbits injected with Vit E or Vit E+Se reached puberty earlier than the other groups. Baladi Black rabbits reached puberty earlier than NZW. Testosterone hormone level in blood plasma was fluctuated from month to month of age for NZW and BB male rabbits. Testosterone level increased ( $P < 0.01$ ) in rabbits injected with Vit E alone or Vit E+Se. Vitamin E in combination with Se improved ( $P < 0.05$ ) ejaculate volume, advanced motility (%) and sperm-cell concentration ( $\times 10^6/\text{ml}$ ) and decreased ( $P < 0.05$ ) dead sperm (%) and sperm abnormalities (%) in NZW and BB rabbits. Rabbits injected with Vit. E+Se or Vit. E increased ( $P < 0.01$ ) fertilizing ability, body weight, testes weights, testis index and epididymis weight for NZW rabbits at 5.5 and 7 months of age. The histopathological examination of male genitalia of the rabbits injected with Se alone showed adverse effect on the genital system. Vitamin E in combination with selenium had obvious improvement on the male genital system. It could be concluded that Vit E+Se injection improved sexual behaviour and increased sexual activity in male NZW and BB rabbits weaned and reared during summer season.

**Key words:** Male rabbit, puberty, semen quality, vitamin E, selenium.

SEMEN EXTENDERS FOR RABBIT  
SEMEN AND ARTIFICIAL  
INSEMINATION IN RABBITS USING  
VASOECTOMIZED BUCK, GnRH OR HCG

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Two experiments were conducted, the first aimed to test three semen extenders for preservation rabbit semen at 5 °C. Egg yolk-Tris was better than Egg yolk citrate or skim milk powder extenders. The recovery rate of forward motility averaged 33.4% after two days of preservation compared to 22.8% or 22.7 % for the other two extenders, respectively. The second experiment aimed to evaluate ovulation stimulators and time of insemination with artificial insemination (AI) in Californian (CL) and New Zealand White (NZW) rabbits. A 2x3x4 factorial arrangement was used. Three ovulation stimulators, 50 IU HCG, 20 mg GnRH and a vasoectomized buck (VB) were used. Four different intervals between the use of ovulators and insemination were tested, 5 h before, zero, 5 and 10 h after induction of ovulation method. About 5 million motile spermatozoa of freshly diluted semen were used for AI. Thirty NZW and 35 CL does were mated naturally as controls. There were no significant differences between breeds for conception rate (CR), litter size (LS) or litter weight (LW). Using VB as the ovulation inducers gave the best response among the three methods. The averages of CR, LS and LW at birth were 66.7 %, 5.4 kits and 326.5 g, respectively. The means were not different from the control except for LS ( $P < 0.05$ ). The values for the control group were 57.0 %, 6.4 kit and 347.4 g., respectively. The poorest

results were 39.6 % CR in the HCG group and 238.0 g. LW in the GnRH group. The averages of CR, LS and LW in the 0 time group were 67.9 %, 5.5 kits and 292.2 g., and were not significantly different from the control group. However AI after 10 hours gave significantly ( $P < 0.01$ ) poorer results (36.1% CR, 3.3 kits LS and 187.1 g. LW). All possible interactions were statistically insignificant. The results of the present experiment indicate that using AI at 0 time with VB as the ovulation inducers gave better reproductive performance than AI at other times using GnRH or HCG. Using VB in AI in rabbits has no side effects such as those that may follow the use of hormonal treatments.

**Key words:** Semen extenders, AI, vasoectomized buck, GnRH or HCG.

MORPHOLOGICAL AND HISTOLOGICAL  
CHANGES OF DIGESTIVE TRACT OF  
RABBITS FED PLANT WASTE  
MATERIALS

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This study was carried out in the Rabbit Unit, Faculty of Agriculture, Mansoura University. The present work investigated the effects of using vegetable market wastes hay (VMWH) in the diets of growing rabbits on their morphological and histological changes of digestive tract. The clover hay was replaced by VMWH at the levels of 10, 20 and 30 % of the diet. The dietary treatment affected significantly the absolute empty weight of stomach and cecum, while of small and large intestine was not affected. However, their relative empty weight of stomach, small and large intestine, and

cecum was not affected significantly by dietary treatments. On the other hand, only the empty volume of small and large intestine and, cecum was significantly affected by dietary treatment. The absolute and relative empty weights as well as volume of all digestive tract organs studied increased significantly by age advancing. There are no differences among dietary treatments were observed in the histological structure of all digestive organs studied. However, developmental changes occurred in the histological structure of the digestive tract organs, which are mainly related to age advancing. The obtained results show that the vegetable market wastes hay (VMWH) can be used to partially replace clover hay in diets of growing rabbits up to 30 % of the diet without any advirsable effects on the morphological and histological structure of different digestive tract segments.

**Key words:** Rabbits, morphology, histology, digestive tract.

EFFECTS OF VITAMINS A AND E  
SUPPLEMENTATION ON  
PERFORMANCE OF PRE AND POST-  
SEXUAL MATURITY OF MALE  
RABBITS, UNDER EGYPTIAN  
CONDITIONS.

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Seventy-two weaned Californian male rabbits aged 5 weeks and 560.5g of body weight were used in the present study. The animals were divided into four equal groups (18 in each one). The first group was kept as control and fed a commercial diet. The

second, third and fourth groups were fed the same diet in the first group supplemented weekly with 400 IU Vit. A, 50mg Vit E and 400 IU Vit A plus 50mg Vit E/ Kg body weight, respectively. Growth performance, body thermoregulation, blood metabolites, scrotal circumference, libido, semen quality and fertility rate were estimated, during summer months. The results showed that daily feed intake and feed efficiency were significantly ( $P<0.05$ ) higher in male rabbits fed vitamins than in control. Final weight, daily weight gain and scrotal circumference were insignificantly higher, while feed efficiency in male rabbits fed Vit. A plus E was significantly higher ( $P<0.05$ ) than the other treated groups. Age at puberty, ear lobe temperature and rectal temperature were significantly ( $P<0.05$ ) lower in the treated groups than the control group. Respiration rate and pulse rate in male rabbits fed Vit. A plus E were significantly ( $P<0.05$ ) lower than in other groups. Total protein, albumin and testosterone concentrations in the treated buck groups were significantly ( $P<0.05$ ) higher than in untreated group, however, globulin, A/G ratio and cholesterol concentrations did not differ due to treatments. Vit. A, Vit. E and Vit. A plus E supplementation improved significantly ( $P<0.05$ ) libido and semen quality of rabbit bucks during summer months. Fertility rate was significantly ( $P<0.05$ ) higher for does mated with Vit. A plus E treated bucks as compared to these mated with control bucks.

**Key words:** Rabbits, vitamins, heat stress, growth, semen, fertility.

EFFECTS OF DIFFERENT EXTENDERS  
AND CRYOPROTECTIVE AGENTS ON  
THE FROZEN RABBIT SEMEN QUALITY

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Twenty New-Zealand White (NZW) buck rabbits were used. Semen was collected, evaluated and extended with each of tris-yolk-fructose (TYF), lactose-yolk-citrate (LYC) and sucrose-yolk-citrate (SYC) extenders. The extended semen was then cooled at 5°C with addition of glycerol or dimethylsulfoxide (DMSO) at levels of 2,4 and 6%. Semen samples were then frozen in straws. Percentages of post-thawing motility, freezability and acrosomal damage of spermatozoa during thawing-incubation at 37°C for up to 2 hours, were estimated. The fertility rate and litter size at birth of seventy two NZW doe rabbits artificially inseminated with fresh extended semen or frozen-thawed semen containing 2% glycerol or 4 % DMSO, were also assessed. The results showed that, freezing of rabbit semen extended with SYC extender containing 2% glycerol or 4% DMSO increased significantly ( $P<0.01$ ) percentages of post-thawing motility and freezability of spermatozoa, however, decreased significantly ( $P<0.01$ ) percentage of acrosomal damage compared to TYF or LYC extender or other levels of glycerol and DMSO. Thawing-incubation time at 37°C for up to 2 hours had a significant ( $P<0.01$ ) effect on decreasing the percentages of post-thawing motility and freezability of spermatozoa, however, the percentage of acrosomal damage increased significantly ( $P<0.01$ ) with the successive time of incubation. The fertility rate of NZW doe

rabbits artificially inseminated with fresh extended semen was significantly ( $P<0.05$ ) higher than frozen-thawed semen added with 2% glycerol or 4 % DMSO, while fertility rate with 4% DMSO was insignificantly higher than 2% glycerol . However, the litter size at birth with different types of frozen-thawed semen was insignificant.

**Key words:** Rabbit, extenders, cryoprotectants, frozen semen, fertility.

FERTILITY TRAITS IN DIFFERENT  
BREEDS OF RABBIT DOES AS  
AFFECTED BY COITUS FREQUENCY  
AND REMATING INTERVAL

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One hundred and eighty rabbits of nine months age of four breeds (35 does and 10 bucks from each of Rex; Flander; Californian and New-Zealand White breeds) were used in two experiments. The first Experiment was conducted to investigate the effect of coitus frequency (one or twice with an hour apart) on kindling rate and litter size at birth of four different breeds of rabbit does, during winter and summer seasons. In the second Experiment, fertility traits of four different breeds of rabbit does as affected by remating interval (0; 7; 14 or 21 days), during winter and summer seasons were estimated. The results obtained from this study indicated that, fertility traits represented by (conception and kindling rates; litter size at birth and at weaning and bunny weight at birth and at weaning) recorded in winter were significantly ( $P<0.001$ ) higher than in

summer season in all studied rabbit breeds. The best values of reproductive efficiency could be arranged descendingly ( $P < 0.001$ ) as obtained by Rex; Flander; Californian then New-Zealand White rabbit does, respectively. The values of kindling rate and litter size at birth resulted from rabbit does mated naturally twice with an hour apart were significantly ( $P < 0.001$ ) higher than those mated only once. Delaying rabbit breeding up to 14 days or more after delivery increased significantly ( $P < 0.001$ ) conception and kindling rates; litter size at birth and at weaning and bunny weight at birth and at weaning in all studied rabbit breeds, during winter and summer seasons.

**Key words:** Rabbit, breed, season, coitus frequency, remating interval.

#### EFFECT OF CENTRIFUGATION AND C-AMP STIMULATORS ON MOTILITY, ACROSOME STATUS AND SOME ENZYMATIC RELEASE OF COOLED RABBIT SPERMATOZOA

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The present study included two experiments. In the 1<sup>st</sup> experiment semen of eight buck rabbits was diluted with citrate-based diluent (1 semen: 6 diluent) and divided into three portions. The 1<sup>st</sup> part was used as a control without centrifugation. The 2<sup>nd</sup> and 3<sup>rd</sup> ones were centrifuged at 600 and 1200 r.p.m. for 10 minutes. The supernatant was removed and the sperm plugs were rediluted to a concentration of  $50 \times 10^6$  spermatozoa. Each portion of the diluent semen was cooled to 5°C over 1.5 hour in a refrigerator and stored at this temperature for two days. At the end of each storage time, the cooled semen was incubated at

37°C for either 0 or 4 hours. In the 2<sup>nd</sup> experiment semen was diluted with citrate-based diluent after collection at 37°C to half the final dilution (1 semen : 3 diluent). The diluted semen was cooled to 5°C over 1.5 hour in a refrigerator and stored at this temperature for two days. At each storage time semen was diluted again with cooled citrate-based diluent (5°C), supplemented with 10 mM per 100 ml diluent of either caffeine and theophylline to give final dilution of 1 semen : 6 diluent and to obtain a final concentration of 5 mM caffeine and theophylline. All semen samples were incubated for either 0 or 4 hours. The obtained results showed that the mean percentage of sperm motility, acrosome abnormalities, activity of lactate dehydrogenase and activity of alanine aminotransferase released into the extracellular medium were not affected significantly by centrifugation. However, centrifugation had a significant effect ( $P < 0.01$ ) on the activity of aspartate aminotransferase released into the extracellular medium. The mean percentage of sperm motility increased and acrosome abnormalities decreased significantly ( $P < 0.05$ ) when rabbit semen was supplemented with caffeine as compared with theophylline supplemented group or control group. Activity of lactate dehydrogenase and activity of aspartate aminotransferase released into the extracellular medium were affected significantly ( $P < 0.05$ ) by c-AMP stimulators. However, activity of alanine aminotransferase released into the extracellular medium was not affected by c-AMP stimulators. The percentages of sperm motility decreased and acrosome abnormalities increased significantly as the period of storage time extended. The mean values of lactate dehydrogenase, aspartate aminotransferase and alanine aminotransferase decreased significantly ( $P < 0.05$  or  $0.01$ ) with increasing the storage time. The mean percentage of sperm motility decreased significantly ( $P < 0.01$ ) with the increase of incubation period from 0 to 4

hours. The mean percentage of acrosome abnormalities increased ( $P < 0.01$ ) with increasing incubation period. The mean values of aspartate aminotransferase and alanine aminotransferase increased significantly ( $P < 0.05$  or  $0.01$ ) with increasing the incubation period from 0 to 4 hours, however, the differences in lactate dehydrogenase were not significant.

**Key words:** Centrifugation, c-AMP stimulators, motility, acrosome abnormalities, liquid storage.

#### REPRODUCTIVE CAPABILITIES OF CALIFORNIAN RABBITS AS AFFECTED BY Gn - RH INJECTION OR SUPPLEMENTATION TO SEMEN

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Thirty bucks and sixty does of Californian rabbits (12 months age) were used in two experiments. Experiment 1 planned to investigate the effect of injecting Californian rabbit bucks with 0.75 µg Gn-RH/Kg body weight in different sites; intramuscularly, subcutaneously, intratesticularly or intravenously on libido and physical semen characteristics. Fertility traits of rabbit does (represented by kindling rate and litter size and weight at birth) mated naturally using Gn-RH injected bucks in different sites were estimated. In Experiment 2, from untreated bucks, semen was collected artificially, pooled and extended with lactose - yolk citrate extender. Gn-RH was added to the extended semen at levels 0, 50, 100, 150 or 200 µg /ml then the extended semen was

stored at refrigeration temperature (4-6°C) up to 3 days, room temperature (18 - 22°C) up to 3 hours or incubation at 37°C up to 4.5 hours. Semen quality was recorded at the different stages of preservation. Twenty Californian rabbit does were inseminated artificially using semen collected from untreated bucks and supplemented with saline solution (control) or 150 µg Gn-RH/ml to estimate kindling rate and litter size and weight at birth. The results obtained from this work showed that, Libido and physical semen characteristics of rabbit bucks injected intramuscularly or subcutaneously with Gn-RH were significantly ( $P < 0.05$ ) better than those of bucks injected intratesticularly or intravenously with the same treatment as assessed by fertility traits of rabbit does naturally mated. Supplementing 150 µg Gn-RH to the extended rabbit semen improved significantly ( $P < 0.05$ ) its quality and viability, during chilled storage at (4-6°C) or preservation at room temperature (18-22°C) and sperm penetration into cervical mucus, during incubation at 37°C. Semen quality was decreased significantly ( $P < 0.05$ ) with progression of time at different preservation temperatures. Kindling rate and litter size and weight at birth values were significantly ( $P < 0.05$ ) better in rabbit does inseminated artificially by using semen supplemented with 150 µg Gn-RH/ml than the control.

**Key words:** Semen characteristics, Gn-RH, semen preservation, fertility traits.

AMELIORATION OF HEAT STRESSED  
BOUSCAT RABBITS BY FEEDING  
DIURNALLY OR NOCTURNALLY DIETS  
CONTAINING *NIGELLA SATIVA* L. OR  
FENUGREEK

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Sixty growing male Bouscat rabbits were used in the present study. The experimental work included two experiments. The first experiment was carried out during pre-sexual maturity (3 months of age) and the second experiment at post-sexual maturity (6 months of age) during summer season. In experiments 1 and 2, rabbits were divided randomly into three equal experimental homogeneous groups. The first group was kept as a control and fed a commercial diet, while the second and third group was fed the same diet supplemented with 5% *Nigella Sativa* L., or 5% Fenugreek, respectively, and divided into two sub-groups according to feeding system either nocturnal or diurnal. Body thermoregulation, some productive and reproductive traits, were recorded. Feed cost value was also assessed. The results showed that, daily feed intake, weight gain and feed efficiency increased insignificantly and increased significantly ( $P<0.05$ ) weight at first mating, while decreased significantly ( $P<0.05$ ) age at first mating in Bouscat male rabbits due to *Nigella Sativa* L. or Fenugreek supplementation to the diet nocturnally compared to the control group or feeding diurnally (Experiment 1). In experiment 2, serum glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), total protein, albumin and total lipids of heat-stressed Bauscat

male rabbits increased significantly ( $P<0.05$ ) due to feed diet supplemented with either 5% *Nigella Sativa* L. or Fenugreek nocturnally compared to the control group or feeding diurnally. The 5% *Nigella Sativa* L. or Fenugreek supplementation to the diet nocturnally decreased significantly ( $P<0.05$ ) ear lobe temperature, skin temperature, rectal temperature, respiration rate and pulse rate of heat-stressed Bouscat male rabbits compared to the control group or feeding diurnally. Feeding nocturnally supplemented with either 5% *Nigella Sativa* L. or Fenugreek improved significantly ( $P<0.05$ ) libido, semen quality and fertility rates of heat-stressed Bouscat male rabbits compared to the control group or feeding diurnally. The feed cost value was superior in the diet supplemented with either 5% *Nigella Sativa* L. or Fenugreek than the control group.

**Key words:** rabbit, nutrition, *Nigella Sativa* L., Fenugreek, heat-stress, semen, fertility.

REPRODUCTIVE PERFORMANCE OF  
GROWING FEMALE NEW ZEALAND  
WHITE RABBITS TREATED WITH GNRH  
ANALOGUE AND GROWTH PROMOTER

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Fifty two growing female New Zealand White aged 60 days and averaged 1562 gm body weight, from the Intensive Rabbit Production Unit, Faculty of Agriculture, Ain Shams University were used in the present study. The animals were randomly divided into 4 experimental groups (13 females per

group): Group 1, animals were injected i.m. with 0.4 µg GnRH analogue (Receptal) 3 times weekly for 4 weeks. Animals of group 2, were injected i.m. with 0.4 µg Receptal 3 times weekly for 4 weeks. A growth promoter (Avotan) was added to the drinking water (0.06 mg / L) during the term of the experimental period; Group 3, Avotan was added to the drinking water (0.06 mg / ml) during the term of the experimental period; Group 4, served as control. The results indicated that GnRH with or without Avotan increased insignificantly daily gain of growing female New Zealand White rabbits; reduced significantly ( $P<0.01$ ) ages at first mating and first kindling than the other groups. Oestradiol 17-β concentration was significantly ( $P<0.01$ ) higher compared to the other experimental groups. Growth promoter group showed higher values of Progesterone concentrations during 1<sup>st</sup> and 2<sup>nd</sup> pregnancies than the other groups. Gestation period length was significantly ( $P<0.01$ ) longer for GnRH + growth promoter group than the other groups. Doe body weight during 1<sup>st</sup> pregnancy was significantly ( $P<0.01$ ) higher than the other groups, but control group showed higher body weight during the 2<sup>nd</sup> pregnancy compared to the other groups. Litter size and litter weight at 0, 1, 2, 3 and 4 weeks were higher for control group compared to the other groups. Mortality rate of litters at 0, 1, 2 and 4 weeks was lower for control than the other groups. Mortality rate from weaning to marketing was higher for GnRH + growth promoter group. Body weight of litters from weaning to marketing was affected significantly ( $P<0.01$ ) by treatment.

**Key words:** Female rabbit, reproduction, GnRH, growth promoter.

## MANAGEMENTS AND HEALTH

### OPTIMUM HOUSING SYSTEM FOR DOE RABBITS IN THE NEWLY RECLAIMED LANDS: PHYSIOLOGICAL RESPONSES

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The study was carried out at Maryout Experimental Station, Desert Research Center, Ministry of Agriculture. The aim was to evaluate two models for rabbit housing, i.e., concrete ground and underground systems versus the current metallic battery type. Comparison based on some physiological responses of 18 New Zealand White doe rabbits (NZW) being allocated randomly to the three housing systems (6 does each) along an experimented period of 12 months covering hot and cold months. Does of the ground system had lowest ( $P<0.05$ ) temperatures of rectum, skin, ear and fur surface and respiration and pulse rates as compared to both underground and battery systems. During the hot months, rabbits showed significantly ( $P<0.05$ ) higher thermo-regulatory parameters than during the cold months. Battery rabbits recorded relatively the highest mean of hemoglobin (Hb) concentration value than those of ground and underground rabbits. The ground rabbits had highest ( $P<0.05$ ) hematocrit (Ht) % value and lowest ( $P<0.05$ ) blood glucose and triiodothyronine ( $T_3$ ) hormone concentrations. Rabbits during the hot season had lower ( $P<0.05$ ) Hb, glucose and  $T_3$  hormone concentrations as compared to values recorded during the cold season. Under extensive rabbit production system in newly reclaimed areas, it might be recommended to the small holders to house their rabbits in the ground type of housing

as an optimum comfort system for certain physiological reasons.

**Key words:** Housing system, thermo-regulation, blood parameters.

PHYSIOLOGICAL PERFORMANCE  
INDICES OF RABBITS' ADAPTABILITY  
UNDER UNTRADITIONAL HOUSING  
CONDITIONS

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Twenty-six New Zealand White rabbit does were used to assess the physiological reaction and biological performance under untraditional housing conditions. The house is made of local available materials (mud, wood, palm reeds, plastic sheet and cement plaster). The study was continued for eight months from April till November. The averages of body temp. (BT) and respiration rate (RR) throughout the experimental period were 39.5 °C and 108.7 rpm, resp. The corresponding averages for hematocrit and hemoglobin values were 32.8% and 12.0 g/dl, resp. The overall averages of  $T_3$  (ng/dl),  $T_4$  (mg/dl) and  $P_4$  (ng/ml) throughout the experimental period were 140.0, 4.8 and 6.6, resp. Up to the 3<sup>rd</sup> parity,  $T_3$  and  $T_4$  showed opposite trends, meanwhile at the last two parities they showed the same trend. The highest levels of  $T_3$ ,  $T_4$  and  $P_4$  were obtained in the 5<sup>th</sup> parity. In general, blood hormones of  $T_3$ ,  $T_4$  and  $P_4$  increased with the advancement of experiment from hot to cold conditions. The averages of litter size (LS) at birth and at weaning were 5.9 and 4.3, resp. The corresponding values of litter weight (LW) were 290.1 and 1602.6 g, resp. Values of LS and LW at both stages showed

the lowest and highest values at the 1<sup>st</sup> and the 4<sup>th</sup> parities, resp. Milk yield averaged 94.6 and 61.5 g at the 3<sup>rd</sup> wk and at weaning (4 weeks), resp. Viability percentage averaged 72.9%, being greatest in the 5<sup>th</sup> parity. It could be concluded that this system of housing with its physical characteristics was suitable for raising rabbits all over the year. Further studies with different materials are needed.

**Key words:** Rabbits, housing, environment, physiological reaction, biological performance.

STUDY OF THE MILK PRODUCTION  
CAPACITY OF AN ALGERIAN LOCAL  
RABBIT POPULATION RAISED IN THE  
TIZI-OUZOU AREA (KABYLIA).

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In order to characterise rabbits of a Kabylia local population raised in Algeria, a study of their milk production was realised in the experimental rabbitry of the Tizi-Ouzou University. Milk production of does was measured every day during the 21 days following 207 parturitions. It was estimated by weighing each litter before and after the single daily suckling (15 - 20 m between the 2 weighing operations). The various controlled parameters were the quantity of milk produced per day, per week and the total quantity produced in 21 days, as well as the

consumption of milk by young rabbits. The analysis concerned the effects of the number of successive litters (4 classes : 1 to 4-and-more) and of the average number of young rabbits suckled per litter (7 classes: from 2-3 kits to more-than-8.0). During the 21 days of controlled lactation, the average litter size was  $5.8 \pm 2.2$ . The rabbit does of the Kabylia local population produced on average 107g of milk / day , that is 2249g in 21 days. The milk intake of young rabbits increased from 12.3 g/day and /animal during the 1<sup>st</sup> week, up to 26.9 g/day during the 3<sup>rd</sup> week of lactation. The number of young per litter influenced in a highly significant way the does' milk production : 64 g/d for 2 to 3 young per litter, up to in 125-130 g/day for more than 6 young. On the other hand the milk production was independent from the parturition's number.

**Key words :** Algeria, milk production, local population.

STUDY OF PROLIFICACY AND ITS  
BIOLOGICAL COMPONENTS IN A  
LOCAL KABYLIAN RABBITS  
POPULATION IN ALGERIA.

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A total of 47 females and 9 males an Algerian local population (Kabylia) bred in rational conditions (raised in wire cages, receiving pelleted food) were studied during

one year in the rabbitry of the University of Tizi-Ouzou. Females were presented to the male from the 10<sup>th</sup> – 11<sup>th</sup> day following every parturition until effective mating, then possibly 12 days later in case of negative palpation. At the end of the experiment, a laparotomy was realised the 12<sup>th</sup> day following the positive mating on a sample of 16 multiparous females to determine the biological components of their prolificity. During the period of study, prolificity at birth and weaning were modest (7.0 total born with 5.9 born alive per parturition and 5.7 weaned kits per weaned litter). The litter and individual average weight at birth and weaning were respectively 297 g, 49.9 g, 2639 g and 49.4g. The study of the biological constituents of the prolificity allowed observing a high rate of ovulation: 14,4 corpora lutea on the whole for both ovaries. On the other hand, the rates of implantation and embryonic survival rates were relatively low : 54.7 % and 34.7 % of ovulated ova respectively. Season of reproduction exert only small quantitative effects even if significant.

**Key words:** Prolificacy, ovulation rate, embryonic survival, litter size, birth, weaning.

RATIONAL RAISING OF RABBIT  
ALGERIAN LOCAL POPULATION:  
FEEDING, GROWTH PERFORMANCES  
AND CARCASS CHARACTERISTICS

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Three tests were realised in order to

determine performances of growth and slaughtering performance of the rabbit of local population fed with a commercial feed or the specific experimental one. A total of 194 rabbits of the local Algerian population were utilised. Several diets were used; they contain different raw materials (Soya meal , Dehydrated alfalfa, Hard wheat bran, Hard wheat middlings, Barley, Field beans, Brewer's grains, Maize, straw). The highest average growth rate observed with rabbits of the Algerian local population is 29 g/d. Its realised with a feed contain + 50 % of wheat by-products. The lowest one is 21.6g/d. The final live weight is modest; it varies of 1658 g to 2060 g at the age of 12 weeks. Slaughter performances are acceptable (64 to 71 %). The utilization of a balanced pelleted feeds improved notably the speed of growth and the weight of slaughtering. However, the level of these performances is lower to the one achieved with rabbits of race improved of means format as the néo-zélandais or the Californian, in similar raising conditions. Considering the gotten performances, the profitability of the exploitation of the rabbit of local population to a rational level is limited again. An improvement of its growth speed is to consider.

**Key words:** Rabbit, feed, growth, slaughtering, carcass

### INCREASE OF RABBIT MEAT PRODUCTION AS MEANS OF INCREASING INCOME IN RURAL DEVELOPMENT VILLAGES IN EGYPT

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To share in solving the economic problems encounter by the Egyptian villages, a great deal of efforts are being intensively exerted to achieve a broad rural development in Egypt. El-Beheira Rural Development project aims to assist farmers in El-Beheira Governorate, to increase meat production, improve and raise their nutritional status and raise their income. A total of 300 rabbits (150 does + 150 bucks) of (New Zealand White, California and Bouscat white) raised and adapted under the Egyptian environment at rabbit research institute belong to the Ministry of Agriculture, were used to investigate and evaluate their meat productivity, reproductivity performance under two systems of management (small and large scale system). Rabbits when reached to a weight of (2800-3300 gm) were divided to two equal groups including equal numbers of each. The first group (75 does + 75 bucks) was raised under the large scale system, while the second group with (75 does + 75 bucks) was distributed on twenty five small holders from 5 villages belonging to El-Behira Rural Development project. Holder received a rabbit battery consisted of 6 cages for 3 does + 3 bucks representing the different three breeds. The study was carried out for a period of one year (1999-2000). A

complete veterinary supervision and technical assistance were supplied. The results were compared together for the following parameters. Litter size at birth (alive/dead) and at weaning (alive/dead), Litter weight at 1 and, 3 months of age, number of services/conception and per year, mortality rate, number of parities/year, meat production Kg/doe/year, net income/year. Differences were highly significant between breads. and between raising systems which were in favour of small holders.

**Key words:** Rural Development program, meat production small holders, large scale rabbit farms, income

#### EFFECT OF BIRTH WEIGHT, MILK SUPPLY STATUS AND FEEDING SYSTEM ON THE MORTALITY OF SUCKLING AND GROWING RABBITS

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Newborn rabbits were divided into three groups on the basis of their birth weight (low = 3545 g. medium = 53-58 g. high = 65-70 g). Half of the litters were reared by one doe and the other half by two does After weaning at 21 days of age. half of the rabbits received ad libitum feeding while the other half were given restricted feeding. 80-85 % of the ad libitum feed consumption. Of all the factors studied only the number of does nursing the young exerted a significant effect on mortality between 0 and 3 weeks of age (the mortality of young nursed by one doe was 22.8% while that of young nursed by two does was 9.4%) There were important differences in mortality between rabbits that had been born with a low,

medium or high weight (23.1. 17.5 and 11.9% respectively,  $P < 0.05$ ). None of the studied factors affected the mortality rate significantly after weaning. The mortality difference between the most disadvantaged group (loss birth weight. nursing by one doe, restricted feeding) and the group being in the most advantageous situation (high birth weight nursing by two does, ad libitum feeding) at 0 – 3 , 3 - 6 and 6-12 weeks of age was 21.8? 2.(.) and 6.6%, respectively.

**Key words:** Rabbits, birth weight, milk supply, feeding regime, mortality,

#### EFFECT OF WEANING AGE, CAGE SIZE AND STOCKING DENSITY ON THE PERFORMANCE OF FATTENING RABBITS

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Conducting a 2x2x2 factorial trial with altogether 632 Pannon White rabbits, half of the litters were weaned at 28 days and the other half at 35 days of age. Both groups were divided into two subgroups where the rabbits were reared in breeding cages (85x55 cm) or moving them to smaller fattening cages (50x33 cm), in both case performing high or low stocking density (8-9 or 6-7 heads/large cage = 18.2 or 13.9 kits/m<sup>2</sup>, and 3 or 2 heads/small cage = 18.2 or 12.1 kits/m<sup>2</sup>). It was concluded that weaning at day 35 resulted in lower mortality rate in the following week compared to the 28 days of weaning. During the whole fattening period,

however, the mortality was similar or higher for older weaning age. There was no significant difference in the growth rate of rabbits weaned at 28 or 35 days of age and in their body weight at 11 weeks of age. Rearing kits in larger groups of 8-9 or 3 animals per cage, respectively, was not disadvantageous because their performance was similar to that of those housed by group size of 6-7 or 2 animals.

**Key words:** rabbit, weaning age, cage size, stocking density.

#### INFLUENCE OF PHYSIOLOGICAL STATUS AND SOME DOE TRAITS ON BLOOD PICTURE IN RABBITS

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Blood samples were collected from ninety-seven does of New Zealand White (NZW) rabbits at mating (53 does) or during puerperium; at 1<sup>st</sup> day of parturition; (44 does). Blood picture and rectal temperature as affected by doe traits (physiological status; doe weight and litter size and litter weight at birth) were studied. Results showed that total erythrocytes (RBCs), haemoglobin concentration (Hb) and the packed cell volume (PCV) were significantly higher ( $P < 0.01$ ) during puerperium than those at mating. No significant differences due to physiological status could be detected for total leukocytes (WBCs) and rectal temperature (RT). Doe weight effect on blood picture was significant only for RBCs and Hb ( $P < 0.05$ ). Effects of litter size and litter weight on all parameters were insignificant except those of litter size on

RBCs; WBCs; Hb and PCV were significant ( $P < 0.05$  or  $0.01$ ). Correlation coefficient among the different parameters were insignificant except those between rectal temperature and each of total leukocytes and live litter size and litter weight at birth were significantly positive ( $P < 0.05$  or  $0.01$ ) during puerperium, as well as, that between rectal temperature and doe weight was significantly negative ( $P < 0.05$ ) for non-pregnant does. The present results indicated that blood picture could be used as a predictor for some productive and reproductive traits of doe rabbits.

**Key words:** Rabbit, physiological status, doe weight, blood picture, puerperium, litter size, litter weight.

#### A STUDY ON SOME FACTORS AFFECTING REPRODUCTIVE PERFORMANCE OF RABBIT DOES

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A total of 847 artificial inseminations (AI) of primiparous and multiparous Pannon White lactating rabbit does were used to study the effect of colour and turgidity of vulva, litter size at AI and days between kindling and insemination on receptivity, fertility and prolificacy. The does with white vulva had the lowest ( $P < 0.01$ ) fertility rate (43.6%) compared to does with red (73.6%) or violet vulva (67.3%). Significant differences ( $P < 0.01$ ) were found between does with white and pink, red or violet vulva in litter size (total and alive). The does with turgid vulva had higher ( $P < 0.01$ ) fertility rate and litter size (total and alive) than those

with a non-turgid vulva (73.2 vs. 48.4, 9.35 vs. 8.72, 9.08 vs. 8.23, respectively). The litter size at AI had no significant effect on receptivity, fertility and litter size. The does inseminated on the 9th day after kindling gave higher ( $P<0.05$ ) receptivity (80.9%) and a not significantly higher fertility rate (72.3%) than those inseminated on postpartum days 10 or 11 (68.8% and 69.9% for day 10 and 65.1% and 66.1% for day 11, respectively).

**Key words:** rabbit, does, receptivity, fertility, prolificacy.

#### PERFORMANCE OF SOME ECONOMIC TRAITS IN NEW ZEALAND WHITE AND CALIFORNIAN RABBITS.

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Two exotic breeds of rabbits; New Zealand White (NZW) and Californian (Cal), were used to evaluate the performance of some litter and body weight traits during three consecutive years under local conditions. Data were collected from 348 litters and 1188 young rabbits. Litter traits evaluated were litter size at birth (LSB) and weaning (LSW), number of born alive (NBA), litter weight at birth (LWB) and weaning (LWW) and mean bunny weight at birth (MBWB). Post-weaning body weights at 4, 8 and 12 weeks and growth rates were also evaluated. Litter size at birth was 7.55 in (NZW) vs 6.41 in (Cal) rabbits and number of born alive was 7.34 in (NZW) breed vs 5.86 in (Cal) breed. Litter weight at birth was 457.77 and 350.76 g in (NZW) and (Cal) rabbits and litter size at weaning was 3.52 and 3.12 in (NZW) and (Cal) rabbits. Litter weight at weaning was 1662.85 and 1259.54 g in (NZW) and (Cal) rabbits and mean bunny weight at birth was 60.21 and 55.56 g in

(NZW) and (Cal) rabbits, respectively. Body weight means were highly significant heavier in (NZW) than those of (Cal) rabbits at 4, 8 and 12 weeks of age. Growth rate means of body weight at 4-8 weeks was 73.9% in (NZW) rabbits while it was 66.4% in (Cal) rabbits. Growth rate means of body weight at 8-12 weeks was 42.8% in (NZW) and 39.1% in Cal rabbits. They were 107.3% and 101.5% in (NZW) and (Cal) rabbits at 4-12 weeks. It was concluded that the performance of some litter and growth traits was better in (NZW) than those of (Cal) rabbits. Although the performance of these two exotic breeds is not fully expressed under the Egyptian conditions, it was higher than those reported for local breeds of rabbits. Therefore, (NZW) and (Cal) rabbits may be used as meat-type breeds under Egyptian conditions. Moreover, crossing between these two foreign breeds and local rabbits may be considered as a tool to help in improving local rabbits.

**Key words:** Performance, litter traits, body weight, growth traits.

#### AUTOGENOUS VACCINATION OF MEAT TYPE RABBITS UNDER EGYPTIAN CONDITIONS FOR CONTROLLING OF RABBIT PASTEURELLOSIS USING PROPIONIBACTERIUM AND LIPOPOLYSACCHARIDES AS IMMUNOSTIMULANT

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In this investigation the effect of autogenous vaccination against rabbit pasteurellosis was studied in rabbits group. Results of serological response as well as reduced mortality rates in vaccinated rabbits

documented the merits of using a vaccine prepared from the same serotype of *P. multocida* isolated frequently from a rabbitary. Immunomodulation with an immunostimulant IM-104 prepared from *Propionibacterium* and lipopolysaccharides resulted in augmentation of both humoral and cellular immune response to the autogenous vaccine. Maternal immunity was followed in the colostrums of vaccinated does as well as in sera of newly born rabbits. The obtained results indicated better transfer of antibodies to the offspring as a result of vaccination and immunostimulation. Carcass quality evaluation indicated higher body weight gains and good carcass traits in the rabbit groups that received autogenous vaccination simultaneously with the immunostimulant IM-104.

**Key words:** Autogenous vaccination, pasteurellosis, propionibacterium, lipopolysaccharides, immunostimulant.

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## NUTRITION AND FEEDING

### EFFECT OF DIETARY PROTEIN AND TOTAL SULFUR AMINO ACID LEVELS ON PERFORMANCE, NUTREINT DIGESTABILITY AND CARCASS TRAITS OF GROWING CROSSBRED RABBITS

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A total of 54 male crossbred growing rabbits (White New Zealand X White Baladi) of 4 weeks old were divided randomly into

six treatment groups equal in number and nearly equal in live weights. Six pelleted experimental diets were formulated. Diets used contained three different levels of crude protein being 14.0, 16.0 or 18.0 % with two levels of total sulfur amino acids (TSAA) being 0.60 or 0.70%. Results obtained could be summarized as follows: The effect dietary protein and TSAA levels on the average body weight gain (BWG) through the experimental period 12 weeks of age showed that the average BWG of growing rabbits fed diet containing 14% crude protein with 0.6 % TSAA were significantly ( $P < 0.05$ ) lower than those of the other treatments. While, the average BWG of growing rabbits fed diet containing 14% crude protein with 0.7% TSAA showed no significant differences compared with other groups. Regarding the dietary crude protein levels, the average BWG of growing rabbits fed diet containing 14% crude protein was significant ( $P < 0.05$ ) lower than those fed diets containing 16% or 18% crude protein. Regarding to supplemented diet with total sulfur amino acids levels the data showed that increasing dietary from 0.6% to 0.7% TSAA significantly ( $P < 0.05$ ) increased the average BWG of growing rabbits. Rabbits fed diet containing 18 % crude protein with 0.6 TSAA significantly ( $P < 0.05$ ) consumed the highest values of feed intake than those of other treatments. While rabbits fed diet of 14 % crude protein and supplemented with 0.6 TSAA significantly ( $P < 0.05$ ) consumed the lowest values of feed intake. Supplemented diets either contained 14 or 16 % crude protein with 0.7 TSAA significantly ( $P < 0.05$ ) improved the feed conversion efficiency. The best value of feed conversion efficiency was recorded for growing rabbits fed diets contained 14% with 0.7% TSAA. The level of 14 % crude protein with 0.7% TSAA numerically improved digestibility coefficient of DM, CP,CF, EE and NFE. Carcass traits relative to the live weight of rabbits at 12 weeks of age, showed that there were no significant ( $P < 0.05$ ) interaction differences in dressing,

giblet and total edible parts. Also chemical compositions of rabbits meat among treatment groups due to TSAA levels within each dietary protein level were not significant. It could be recommended that using lower level of protein 14 % with increasing TSAA by 0.10 % than recommended level in diets of crossbred growing rabbits is sufficient and can be used as an economical advantage in saving the cost of feed.

**Key words:** Growth performance, digestibility, carcass dietary protein level, and dietary protein level.

#### EFFEC OF DIETARY PROTEIN LEVEL ON GROWING AND MATURE RABBITS PERFORMANCE, UNDER SUMMER CONDITIONS OF EGYPT

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Eighty weaned males of 5 weeks of age and 812.75g body weight, forty adult females of 6 months of age and twenty adult males of 6 months of age, New Zealand White(NZW), rabbits were used to study the effect of different dietary crude protein level ( 16, 18 and 20% for growing rabbits and 18, 20 and 22% as crud protein for adult females and males), under the summer conditions of Egypt, on growth and reproductive performance. The results obtained for growth showed that, the live body weight, live body gain, dressing percentage, feed intake, feed conversion and final margin were affected by summer heat stress when compared with winter condition. Increasing dietary protein level from 16 to 18 or 20% for growing rabbits increased significantly ( $P<0.001$ ) final live body weight with 15.27% in group received 20% crud protein, and live body gain during

experimental period increased insignificantly with 14.73 and 29.00% by using diet contained 18 and 20% crud protein, than in the summer control group (received 16% crud protein), while all groups under the summer condition (received 16,18 and 20% crud protein), decreased significantly ( $P<0.001$ ) final live body weight with 27.37, 21.64 and 16.28% and live body gain during experimental period with 42.06, 33.52 and 25.25% respectively, than in the winter control group. Feed conversion and dressing percentage values were improved by using high protein level in rabbits diets under the summer condition. Feed conversion and dressing percentage were the best under the winter condition. The results obtained for reproductive performance showed that, the conception rate, litter size at weaning, litter weight at birth and weaning, pups pre-weaning weight gain, pre-weaning mortality, semen volume, mass motility, advanced motility, dead spermatozoa and sperm concentration were affected by summer heat stress compared with winter conditions, increasing dietary protein level from 18 to 20 or 22% for adult females and males NZW rabbits showed some beneficial effects on this traits under the summer condition.

**Key words:** Rabbits performance, season, protein level, carcass traits , reproduction traits, semen characteristics.

EFFECT OF KEMZYME IN RABBIT  
RATIONS DIFFERING IN THEIR PROTEIN  
LEVELS ON DIGESTION, BLOOD  
CONSTITUENTS AND CARCASS  
TRAITS

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Sixty New Zealand White growing male rabbits about four week of age and initially weighing 717.3 g were distributed in four experimental groups (15 rabbits in each), which were fed four different diets. The diets were formulated to be contain two levels of protein 16 and 18% . Each protein level was supplemented without or with Kemzyme of 1 g/kg diet during the expermental period ( 12 weeks). The results indicated that final body weight and daily gain improved not significant with supplementation of Kemzyme, except feed conversion rate were significant ( $P<0.05$ ). How ever, digestion coefficient of all nutrients and nutritive values were significant ( $P<0.05$ ) improved by enzyme supplementation. Values of TDN and DCP percent were significantly ( $P<0.05$ ) increased by adding Kemzyme diets when compared to the control groups . Serum creatinine and GOT level increased ( $P<0.05$ ), while cholesterol and GPT level was decreased ( $P<0.05$ ) in growing rabbits fed the enzyme supplemented when compared with those fed the unsupplemented diet. Results of the study indicated that the high level of protein (18%) in the ration with addition of 1 g/kg ration of Kemzyme is recommended for good growth performance and carcass traits of growing rabbits under

the Egyptian conditions.

**Key words:** Kemzyme, digestibility, blood constituents, carcass traits.

THE USE OF BIOGEN AS A NATURAL  
GROWTH PROMOTER FOR GROWING  
NEW ZEALAND WHITE RABBITS

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The present experiment was carried out in order to investigate the effect of biogen (a commercial growth promoter from natural sources) in growing rabbits diets with two dietary protein levels on growth performance, nutrient utilization, carcass traits, some blood components and economic efficiency. Forty growing NZW rabbits were assigned to four groups fed 4 different diets containing two levels of crude protein (low level, **LL**, 14.12% or high level, **HL**, 18.22% without or with 1g biogen/kg diet) from 6 to 12 weeks of age. Results revealed that, the high protein diet (HL) or biogen addition showed significantly ( $P<001$ ) higher final body weight, daily gain, while feed intake decreased. Feed conversion and economic efficiency improved also with the higher dietary protein level without or with biogen supplementation. Digestion coefficients of all nutrients and nutritive values as digestible crude protein (DCP), total digestible nutrients (TDN) and digestible energy (DE, Kcal/Kg) were improved significantly when dietary protein was increased or addition of biogen. Carcass, edible meat and total giblets percentages were increased with the same treatments. The high level of protein along with addition of biogen significantly increased the carcass crude protein and decreased the ether

extract. Biogen supplementation decreased serum total cholesterol and lipids meanwhile creatinine, uric acid, serum glutamic oxaloacetic and glutamic pyruvic transaminase enzymes (GOT&GPT) and alkaline phosphatase were not affected, indicating the safety of use biogen at the level of 1 g/Kg diet. Data indicated the beneficial economical effect of using biogen with low protein diet to reach almost the same performance with high protein level.

**Key words:** Biogen, growth, digestibility, carcass, serum components.

#### EFFECT OF DIET SUPPLEMENTATION WITH BIOGEN ON DIGESTIBILITY AND GROWTH PERFORMANCE OF GROWING RABBITS

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A total of forty eight male New Zealand White rabbits (NZW) of 6 weeks of age with an average initial body weight  $785 \pm 28.3$  g were used to study the effects of Biogen supplementation on growth performance, digestibility of nutrients, chemical composition of soft and hard feces, carcass traits, constituents of blood plasma, chemical and physical composition of meat and economical efficiency. Rabbits were distributed into 4 groups of twelve rabbits each. Diet 1 served as control, while diets B1, B2 and B3 were supplemented with 0.1, 0.15 and 0.2% Biogen, respectively. Results

obtained up to 14 weeks of age showed that the final body weight, daily weight gain and performance index increased significantly ( $P < 0.05$  or  $0.01$ ) in groups fed diets supplemented with Biogen especially diets B2 and B3. Also, Biogen supplementation showed better ( $P < 0.01$ ) feed conversion than the control group. Digestibility values and feeding values as TDN, DCP and ME were significantly higher ( $P < 0.05$  or  $0.01$ ) with Biogen supplementation diets (0.15 and 0.2%) than with the control group. Rabbits fed diets supplemented with 0.15 and 0.2% Biogen excreted higher crude protein in soft feces and lower in hard feces. Crude fiber content of soft and hard feces was the lowest ( $P < 0.05$ ) in groups supplemented with 0.15 and 0.2% Biogen. Carcass traits was insignificantly affected with Biogen dietary supplementation, except dressing %, hot and cold weight. The dietary supplementation with Biogen significantly ( $P < 0.01$ ) increased protein % and water holding capacity of rabbit meat, while the tenderness was insignificantly increased. The energy value of the rabbit meat was decreased ( $P < 0.01$ ) in groups fed diets supplemented with Biogen. The highest economical efficiency value was recorded in group fed diet B2 supplemented with 0.15% Biogen.

**Key words:** Biogen, probiotics, growth promoters, rabbit performance, digestibility, carcass, serum constituents.

SAGE AND YARROW AS NATURAL  
BIO-STIMULATORS AND  
DETOXICANTS AGAINST LEAD IN  
GROWING RABBITS DIETS.

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The role of sage and yarrow as natural bio-stimulators and as detoxifying agents against lead was studied in 72 male growing New Zealand white (NZW) rabbits. Rabbits were divided into 8 equal groups. The first and second groups were used as positive and negative controls that received basal diets either free or supplemented with 1/5 % LD<sub>50</sub> of lead, respectively. Groups from three to six received free basal diets supplemented with either sage or yarrow at the dose of 0.5 and 1.0 %, respectively. Groups seven and eight received contaminated diets plus 1.0 % of either sage or yarrow, respectively. Sage supplementation at the two doses and yarrow at 1.0% significantly ( $P<0.05$ ) increased the final body weight and the absolute daily body weight gain compared with the positive control group. On the other hand, lead treated group showed significant decrease in all performance parameters, while supplementation 1.0% sage or yarrow to the contaminated diets significantly improved the final body weight, daily body weight gain and daily feed intake. Rabbit groups that received the two doses of sage or yarrow showed significant improve in hemoglobin level and PCV %, compared with the positive control group. Adding sage at the two doses with free basal diets significantly improved the values of total protein and cholesterol levels. In the

contaminated control diet, large disturbance occurred in all performance measured and blood parameters, while adding sage or yarrow to the same diets, improved significantly the most of these parameters. Rabbit groups that received 1.0 % of either sage or yarrow supplemented with free basal diets showed significant increase in crude protein digestibility coefficient.

**Key words:** Sage, yarrow, digestibility, growth, bio-stimulators, detoxification, blood parameters.

CLAYS IN ANIMAL NUTRITION:10.  
DETOXIFICATION OF AFLATOXIN B<sub>1</sub>  
BY TAFLA CLAY IN RABBIT FEEDS.

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Reduction of aflatoxicosis in growing rabbits feeds was examined by adding different levels of tafla clay to aflatoxin B<sub>1</sub> contaminated diets for 38 days. Twenty five growing New Zealand White (NZW) male rabbits were assigned to five experimental diets. The 1st one served as control, the 2<sup>nd</sup> contaminated with 125ppb aflatoxin B<sub>1</sub> and the other experimental diets contained the same level of aflatoxin B<sub>1</sub> plus 0.25 , 0.5 or 1% tafla, respectively. Results obtained could be summarized as follows : Aflatoxin B<sub>1</sub> decreased the rabbit performance. The average body weight, daily body gain, feed intake and feed efficiency decreased in total period by 29.71, 52.53, 52.87, 38.46% respectively, in comparison with control one. The digestibility coefficients of dry matter, organic matter, crude protein, crude fiber and nitrogen free extract decreased by 7.53, 4.18, 3.32, 10.81, 7.36% with aflatoxin B<sub>1</sub> contaminated diet without fafla in comparison with the control ones. Also,

aflatoxin B<sub>1</sub> decreased blood total protein, albumin, globulin, total cholesterol, creatinine, glutamate oxaloacetate transaminase, (GOT), glutamate pyruvate transaminase (GPT) and total lipid. The absolute weight of the internal organs (liver, spleen, kidney, testis and lungs) decreased by aflatoxin but the weight of the same organs as % of body weight were increased. Addition of tafla to aflatoxin B<sub>1</sub> contaminated diet improved the growth performance. The daily body weight gain, feed consumption and feed efficiency improved with 0.25, 0.5 and 1.0 % tafla addition by 30.84, 40.25 and 47.07% ; 21.55, 41.62 and 65.2% ; 12.5, 18.75 and 6.25% , respectively, in comparison with the aflatoxin contaminated diet without tafla. The digestion coefficients, nutritive values, serum constituents and internal weight of organs did not differ significantly by aflatoxin B<sub>1</sub> with or without tafla. These data suggest that adding tafla (specially 0.5 and 1%) to aflatoxin B<sub>1</sub> contaminated diet can play practical role in detoxification of effect aflatoxin B<sub>1</sub> in rabbit diets.

**Key words:** Rabbits, aflatoxin, tafla, growth, blood.

INFLUENCE OF SUBSTITUTING  
CONCENTRATE FEED MIXTURE BY  
*NIGELLA SATIVA* MEAL ON THE  
PERFORMANCE OF GROWING RABBITS

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This study was conducted to investigate the effect of replacing concentrate feed mixture (CFM) protein by *Nigella Sativa* meal (NSM) protein at the rate of 0 , 25 and 50% in practically three iso-nitrogenous and iso-caloric pelleted mixed diets on the performance of New-

Zealand White (NZW) weanling rabbits. Forty five weaned at 42 days (NZW) male rabbits were used and allotted randomly into 3 groups of 15 animals of each. The initial average live body weight values were 855, 867 and 860 g for the control, 25 and 50% NSM-protein groups, respectively. The results indicated that the control group gained more weight than the groups fed diet contained 25 and 50% NSM-protein. The control group had more intake than the tested groups. A significant decrease in body weight and feed intake was recorded in the treatment groups compared to the control group. Also, feed conversion ratios were 5.4, 5.0 and 4.8 for the control, 25 and 50% NSM-protein, respectively. Carcass yield and liver weight were not affected by replacing NSM-protein. No significant difference was found between all of the three groups in the digestibility of DM and CF. There were significant decrease on digestibility of OM, CP and NFE. However, there was significant increase on digestibility of EE as a result of using NSM . Group 3 (50% NSM-protein) achieved the highest dressing weight (1612 g) followed by the control group (1595 g) and 25% NSM-protein (1513 g) with no significant differences. The group fed diet containing 50% NSM-protein achieved the best of both economical efficiency (EE) and relative economic efficiency (REE) (193.9 and 138.3%) respectively .

**Key words:** *Nigella Sativa* meal, growing rabbits, digestibility, nutritive value, carcass

BLACK SEED FORMS AND ITS EFFECT  
ON RABBITS PERFORMANCE AND  
BLOOD CONSTITUENTS

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Forty New Zealand White rabbits about 42 days of age were assigned to four experimental group (ten rabbits each). Rabbits were fed a commercial diet containing about 17% crude protein and 2700 kcal digestible energy. Diets were supplemented with different forms of black seed (BS) as follows : 0 supplementation (control), 1g black seed (as it is), 1 g crushed black seed/kg and 1 g black seed oil/3 kg diet for groups 1, 2, 3 and 4, respectively. Growth performance, carcass characteristics and blood constituents were determined. The results showed that body weight and gain were improved significantly in groups 2 and 3 compared to groups 1 and 4 with no significant differences between either groups 2 and 3 or 1 and 4. Feed conversion was significantly improved in group 3 compared to other groups. Dressing % improved and abdominal fat decreased significantly in treatment groups compared to control. There were a significant improvements in Ht, Hb, GOT and GPT in treatment groups compared to control, while there were a significant decrease in total lipids and cholesterol in treatment groups compared to control. Also, it can be notice some increase in WBCs, total protein, Alb and Glb in groups 2, 3 and 4 compared to group 1. It can be concluded that the crushed black seed recorded the best results compared to the other ways of supplementation and it can be recommended as the best form of the BS supplementation.

**Key words:** Black seed, performance, blood.

EFFECT OF FEEDING DIFFERENT  
LEVELS OF MALT AND SUNFLOWER  
SEED MEAL ON BROILER RABBITS  
PERFORMANCE

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Forty weaned (6 wk of age) male New Zealand White (NZW) rabbits of approximately similar weights were assigned at random to four experimental groups. These groups were Control (0% malt) and 5, 10, 15 % malt additions (derived from beer manufacturing). The four experimental diets were almost isonitrogenous and isocaloric. Traits evaluated were Growth performance (Final body weight at 14 wk of age; Daily gain; Feed intake and feed conversion ratio); nutritive values as well as serum constituents (sGOT; sGPT; Total lipids; Albumin; Globulin and Protein). Results indicated that growth performance was significantly ( $P \leq 0.05$ ) enhanced by malt additions.

**Key words:** Rabbits, malt, growth performance, digestibility coefficients, serum constituents.

RESPONSE OF GROWING RABBIT  
PERFORMANCE TO SOME DIETARY  
VEGETABLE OILS AND THEIR CA-SOAP

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One hundred and sixty two weanling New Zealand White rabbits 7 week old were used for conducting two experiments, of eighty one rabbit each. The rabbits of each experiment were distributed at random into 9 experimental groups from T1 to T9 which were similar in average weight and number of rabbits. Each group involved nine experimental animals in three replicates and assigned to one of the experimental treatments. In the first experiment, three different vegetable oil sources (sunflower, linseed and palm oil) were used, each at three levels (3, 6 and 9%) in a 3X3 factorial design to study their effects on rabbit performance. In the second experiment, a 3X3 factorial design was conducted using the Ca-soap of such vegetable oil sources, each at three levels (3,6 and 9%), to study their effect on rabbit performance. Results obtained could be summarized as follow: 1. Palm oil was the best source for feeding growing New Zealand White rabbits from 7 to 15 weeks of age as compared to the other vegetable oil sources used in the present study. 2. Final body weight (FBW) and body weight gain (BWG) of rabbits fed diets supplemented with 3% palm oil were the best, while the least were those fed 9% linseed oil. The feed conversion (FC), showed better values for rabbits received 3 or 6% palm oil, while those fed diets supplemented with 9% sunflower oil, 6 or 9% linseed oil exhibited the worst. 3. Rabbits fed diets supplemented with palm oil showed better values of absorbability and economical efficiency, while those fed linseed oil recorded the least. 4. The FBW and BWG as well as the FC values of the

experimental rabbits improved when the tested vegetable oils were introduced in the diets as Ca-soap derivatives. The Ca-soap processing tends to enhance the absorbability rate of such vegetable oils, therefore, the use of sunflower oil Ca-soap was economically more efficient than either linseed oil or palm oil Ca-soap derivatives. 5. Feeding growing rabbits on diets supplemented with palm oil Ca-soap resulted in significant increase ( $P<0.05$ ) in plasma total lipids and total cholesterol compared to either sunflower oil Ca-soap or linseed oil Ca-soap sources irrespective of their level. 6. Meat of rabbits received palm oil as more acceptable when compared to the other oil sources, however, no significant differences were detected among treatments. Accordingly, palm oil in its natural form is the best for feeding growing rabbits and not recommended to be used as Ca-soap, while the Ca-soap of linseed oil could be used safely and efficiently in rabbit diets.

**Key words:** Oil, Ca-soap, rabbit, growth, absorbability.

INCLUSION OF LIGHT SUNFLOWER  
SEEDS IN GROWING RABBIT DIETS.

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The study aimed to evaluate using light sunflower seeds (LSS) in growing rabbit diets. Two experiments were carried out in this respect. In experiment 1, thirty six males of New Zealand White rabbits of 6 weeks old were divided into three equal groups. Light sunflower seeds (LSS) were used at 0, 17.5 and 35.0% levels. Feed and water were available ad libitum for 6 weeks. Experiment 2 aimed to study the effect of lower levels of LSS (12 and 24%) compared with the high

LSS contained diet (35%) as control diet. Thirty males of 5 weeks old NZW rabbits were used. Rabbits were offered for 8 weeks feed and water ad libitum. Nutrients digestibility, growth performance, carcass traits and economic efficiency of using LSS in rabbit diets were studied. The results showed that rabbits were able to digest protein, fat, fibre and carbohydrates of LSS more efficiently than those of clover hay. Replacing clover hay by LSS at levels up to 35% achieved growth performance as high as control group. There were no significant differences between diets on dressing, boneless and chemical analysis of carcass flesh. The relative EEF. Values were 100.4 and 105.0% for 17.5 and 35% LSS diets, respectively. The results of digestion trial of experiment 2 showed that nutrients digestibility decreased as LSS levels decreased. Sawdust had an adverse effect on digestibility. Rabbits had low ability to digest sawdust especially its fibre content. It is concluded that adding LSS in growing rabbit diets at levels up to 35% achieved performance as good as clover hay had with no adverse effects on digestibility, carcass traits and economic efficiency.

**Key words:** Sunflower, carcass, economic efficiency.

#### UTILIZATION OF POTATO PROCESSING BY-PRODUCTS AND SWEET POTATO TUBERS AS NON-CONVENTIONAL ENERGY SOURCES BY GROWING RABBITS

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This study was conducted to investigate the possibility of using potato

processing by-products meal (PPM) and discarded sweet potato tubers meal (SPM) as cheap alternative energy sources in the ration of growing rabbits at levels of 10, 20 and 30%. A total of 56, five weeks old white New-Zealand male rabbits were allotted randomly to 7 dietary treatments 8 animals each. Experimental period was lasted 10 weeks. Experimental rations were formulated nearly to be iso-caloric and iso-nitrogenous. Results obtained indicated that no significant differences were found among all groups in relative growth rate (RGR), final body weight and weight gain. Groups fed (PPM) or (SPM) were ( $P<0.05$ ) better in feed conversion ratio (FCR) compared with the control. Significant effect was observed on protein efficiency ratio (PER) and energy efficiency ratio (EER) due to feeding rabbits on 10% (PPM) or 10, 20 and 30% SPM. No significant differences were found among tested groups in the digestibility coefficient of DM, OM, CP and NFE. Groups fed 20 and 30% PPM were ( $P<0.05$ ) higher in EE digestibility than other groups. Also groups fed 30% SPM was ( $P<0.05$ ) better in CF digestibility than other groups. No differences were found among all tested groups in TDN, SV and DCP. Nitrogen balance was positive for all groups, however, differences were insignificant. No significant differences were found among the tested groups in carcass traits and quality. Therefore, it is worth to recommend adding these two by-products up to 30% to the rations of growing rabbits without any adverse effect on its growth performance or health.

**Key words:** Potato by-product meal, sweet potato meal, digestibility, nitrogen balance, carcass traits.

EFFECT OF USING GRADED LEVELS OF  
*PHASEOLUS VULGARIS* STRAW IN  
GROWING RABBIT DIETS

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This study was conducted to evaluate the effect of replacing *Phaseolus vulgaris* straw (PS) instead of clover hay in rabbit diets at levels of 0, 10, 20 or 30% of the diet on some growth performance traits, digestibility coefficients, carcass traits and some blood parameters of growing rabbits from 6 to 14 weeks of age. In addition, the effect of enzyme preparation (Kemzyme) supplementation to the diet contained 30% PS was also investigated. Sixty growing New Zealand White rabbits (NZW) at 6 weeks of age were divided into five experimental groups, each of 12 animals. Each group was fed on one of five experimental diets. The first group was considered as control (without PS). The 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> diet included 10, 20 and 30% PS instead of clover hay, respectively. However, the 5<sup>th</sup> diet included 30% PS with Kemzyme supplementation at a level of 1.0 g/kg. The obtained results could be summarized as follows: Replacing clover hay by *Phaseolus vulgaris* straw (PS) significantly ( $P \leq 0.01$ ) increased live body weight, daily weight gain and daily feed intake, however, feed conversion, protein efficiency ratio, efficiency of energy utilization, performance index, feed cost /kg gain, economic efficiency and nutritive values of the diets were not affected. Inclusion of PS in rabbit diets increased digestibility coefficients of dry matter, crude protein and ether extract, however, the other nutrients (organic matter, crude fiber and nitrogen free extract) were not affected. Carcass traits were not affected by inclusion of PS in rabbit diets instead of hay clover in rabbit diets. Most of blood constituents,

measured herein, (sedimentation rate, serum concentration of total protein, total lipids, glucose and cholesterol and the activity of GPT in blood serum) were not affected by replacing clover hay with PS in rabbit diets, while the activity of GOT in blood serum was decreased significantly ( $P \leq 0.05$ ). The addition of enzyme preparation to the diet contained 30% PS did not show positive effects on the various studied criteria.

**Key words:** *Phaseolus vulgaris* straw, growing rabbits, carcass traits.

IMPROVING THE NUTRITIVE VALUE OF  
SOME ROUGHAGES USED FOR  
RABBITS FEEDING

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This study was carried out in the house of the by-products utilization Department at Animal Production Research Institute (APRI), Egypt to compare the effect of feeding bagasse, rice straw and wheat straw untreated or biologically treated with fungus (*Trichoderma reseei*) under different levels 5, 10, 15% of untreated or treated roughages, on the performance of growing rabbits at 5 weeks. A feeding trail of 8 weeks was carried out with 171 male of New Zealand rabbits divided into 18 groups and one group for control to compare the results. The animals were randomly distributed, nine animals under any level of any roughages (treated or untreated). Diets were fed ad lib. for 8 weeks, and on experimental digestion was carried out at the end of nutrition the experiment, before slaughter. From the present work it can be concluded that,

biological treatments improve and increase the nutritive value of roughages, there were significant differences between untreated and treated rations for the three roughages and between levels under the same roughage. The best body weight gain was for rabbits which eat 5% treated rice straw (33.19g/day), feed consumption was decreased and there was an increase in feed conversion for the groups fed the biologically treated roughages and showed higher feed digestibility CP, CF, EE, OM, NFE and economical efficiency higher than untreated. Treated rice straw was better than treated bagasse or treated wheat straw. The best economical efficiency was for the ration which contain 10% treated rice straw

**Key words:** Rabbit, roughages, rice straw, wheat straw, bagasse, fungi.

#### EVALUATION OF SWEET LUPIN (*LUPINUS ALBUS*) AS GREEN FORAGE FOR SHEEP AND RABBITS

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Two feeding experiments were conducted with sheep and rabbits. In experiment 1, six metabolism trials were carried out using local sheep and New Zealand White rabbits (three trials for each species) to evaluate the nutritional value of green forage of sweet lupin forage alone or mixed with green barley under Egyptian conditions. In experiment 2, sixty growing NZW rabbits (30 males and 30 females aged 5 weeks and averaging 520.7 g weight were

distributed into three groups on basis of body weight and sex fed the following diets: (1) 100% pelleted complete feed (PCF), which served as a control ad libitum, (2) 80% PCF + lupin forage ad libitum and (3) 60% PCF + lupin forage ad libitum. In the first experiment, the obtained results revealed that, green forage of sweet lupin was palatable (average dry matter intake was 2.62 and 1.92 of body weight for sheep and rabbits, respectively) with a good digestibility for most nutrients especially for 1<sup>st</sup> cut and was high in its nutritive values. N-balance was positive for sheep and rabbits. In second experiment, dry matter intake and daily body gain of growing rabbits fed diet 3 were decreased ( $P < 0.05$ ) than those fed the other diets. Also DM, OM, CP, CF, and NFE digestibilities and nutritive value by growing rabbits fed the same diet were decreased ( $P < 0.05$ ) than those fed the other diets. The dressing % decreased ( $P < 0.05$ ) while, the alimentary tract % increased ( $P < 0.05$ ) with increasing the level of lupin forage in the diets. The serum protein, albumin, globulin, total lipids, cholesterol, urea-N, creatinine, GOT and GPT were not affected significantly by feeding rabbits lupin forage.

**Key words:** Lupin forage, rabbit performance, digestibility, blood metabolites.

REPRODUCTIVE PERFORMANCE AND  
BLOOD CONSTITUENTS OF BUCK AND  
DOE RABBITS FED DIET  
SUPPLEMENTED WITH SOME  
PROBIOTIC AND HERBAL ADDITIVES

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Thirty six doe and twenty seven buck Bouscat rabbits, 24 weeks old were used. They were divided into nine similar groups of 4 females and 3 males in each according to type of diet. The experimental groups were fed on diet without supplementation as control group or with Lacto-Sacc at 1.0 and 2.0 g/kg diet, yeast culture at 1.0 and 2.0 g/kg diet, Cocci-Nel at 0.75 and 1.5 g/kg diet and Lomoton at 0.75 and 1.5 g/kg diet to study their effect on reproductive performance and blood constituents of doe (for three parities) and buck rabbits. The present results revealed that, there is no significant difference among groups in the ejaculate volume while buck rabbits fed control group recorded the better value for wave motion, sperm motility, dead, abnormal spermatozoa and sperm concentration followed by rabbits given Lacto-Sacc and the lowest values recorded when buck rabbits fed Cocci-Nel supplementation. Furthermore, conception rate recorded the highest value with the addition of yeast but the lowest value found with the addition of both control and Cocci-Nel treatments. Doe rabbits given Lomoton had higher litter size and litter weight at birth, 21 and 28 days old but lower values were obtained with the supplementation of either Lacto-Sac or yeast culture. Bunny weight at birth, 21 and 28

days improved significantly (0.05) when rabbits fed yeast while those fed Lomoton recorded the highest value for litter weight gain from birth to 28 days and from 21 to 28 days. The buck rabbits fed diet supplemented with Lomoton had a marked increase in blood protein, albumin, globulin, cholesterol, GOT, GPT and alkaline phosphatase but lower values for lipids than other groups. Concentration of lipids recorded the highest value but GOT, GPT and cholesterol recorded the lowest values when rabbits fed 1.0 g/kg diet of yeast culture. Moreover, rabbits consuming Cocci-Nel (1.5 g/kg diet) had significantly ( $P<0.05$ ) lower values of blood protein, albumin and globulin than other groups.

**Key words:** Probiotics, herbs, semen quality, reproductive performance, blood constituents.

EFFECTS OF VITAMIN C AND E  
SUPPLEMENTATION ON BLOOD  
CONSTITUENTS AND REPRODUCTIVE  
PERFORMANCE IN BUCK AND DOE  
BOUSCAT RABBITS

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Two experiments were carried out in this study. In the first experiment, 24 Bouscat buck rabbits of 12 months old with 3550 + 85 g were used. The experimental bucks were divided into four similar groups (6 bucks in each) according to type of feed additives. The first group was fed basal diet as a control diet ( $G_1$ ), however the other groups 2, 3 and 4 were fed the control diet with the supplementation of 2 g vitamin C ( $G_2$ ), 2 g

vitamin E ( $G_3$ ) and 1 g vitamin C and 1 g vitamin E ( $G_4$ )/kg diet. After 15 days of starting the experiment, blood samples were collected biweekly interval for 7 times, while body temperature, respiration rate and semen characteristics were achieved weekly for 7 weeks. In the second experiment, 42 Bouscat doe rabbits aged 12 months old were allotted into 7 similar groups (6 does in each). The doe groups 1, 3, 5 and 7 fed the same diets as in the buck groups 1, 2, 3 and 4, respectively and naturally mated with the bucks of the previous groups. The other doe groups 2, 4 and 6 fed the control diet and mated with the previous bucks groups 2, 3 and 4, respectively. The results from this study showed that serum total protein, albumin and globulin values were significantly ( $P < 0.05$ ) higher in  $G_2$  than the other groups. As well as, the highest values of cholesterol, GOT, GPT, creatinine and urea were recorded in the control group. Furthermore, wave motion, motility, sperm concentration/ml were recorded the highest level in the  $G_3$ . On the other hand, the experimental rabbits fed control diet without additives had higher the percentage of dead and abnormal spermatozoa, but it lower in ejaculate volume, motility and concentration of sperm/ml than the other groups. Furthermore, the results revealed that the numbers of offspring, survival at birth and 28 days old, litter weights at birth and 28 days old were recorded the highest value in the  $G_5$ , while the lowest values observed in the first group. Milk yield at birth, 21 and 28 days post kindling were lower in the control group than the other groups.

**Key word:** Vit C& E, blood constituents, reproductive performance.

## UTILIZATION OF PEA AND CITRUS PULP BY PRODUCTS IN RABBIT DIETS

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One hundred growing New male Zealand White (NZW) rabbits aged 5 weeks with 563.37 g average live body weight were divided into random five experimental groups (20 each) and fed on five different diets contained yellow corn grain (YCG) as a main source of energy that was replaced by 0, 33 and 66% pea by-products (PBP) or dried citrus pulp by-products (CPBP) i.e. 10 and 20 % from the total diets. The feeding experiments extended for 13 weeks. Protein efficiency ratio (PER), efficiency of energy utilization (EEU), performance index (PI%), nutrients digestibility, carcass characteristics, economical efficiency were studied throughout the experimental period. The obtained results indicated that, replacement of yellow corn with 33 or 66% PBP or 33% CPBP significantly ( $P < 0.05$ ) significantly affected growth performance of growing rabbits. The partial replacement of yellow corn by 66% PBP or CPBP significantly ( $P < 0.05$ ) increase daily weight gain, feed conversion, growth performance index, while, the feed conversion ratio of rabbits fed diets replaced with 33% PBP or CPBP tended to be lower ( $P < 0.05$ ) than rabbits fed the control diet. Also, results showed that various digestibility coefficients affected significantly ( $P < 0.05$ ) with the partial replacement of PB or CPBP instead of yellow corn grain. The nutritive value of the tested rations whither expressed as TDN, DCP or ME had approximately the same trend. The TDN, DCP and ME values were increased significantly ( $P < 0.05$ ) with increasing the level of replacement by 16.43, 12.22 and 6.66% in group fed 66% PBP diet and by 13.00, 1.39 and 5.97% in group fed

66% CPBP diet, respectively, compared with those fed the control diet. Hot carcass weight and dressing percentages were higher significantly ( $P<0.05$ ) in the 66% PBP or CPBP group than those of the control group. No significant differences among the experimental groups in chemical composition of meat of rabbits. It could be concluded that, pea by-products and dried citrus pulp can be partially replaced by 66% instead of yellow corn grain (20% from total diet) in the pelleted diets of growing male rabbits without any adversely effect on growth performance of rabbits.

**Key words:** Pea, citrus pulp, by-products, rabbit.

#### EFFECT OF AFLATOXIN AND ASCORBIC ACID ON THE GROWTH FORMANCE OF RABBITS

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The effect of given aflatoxin ( $AFB_1$ ) and ascorbic acid (AA) was investigated using thirty male NZW rabbits aged 6-7 months, weighting  $3.12 \pm 0.07$  Kg. Six groups of animals (8 each) were used to be fed diet contained 18% CP (control), receiving a dose of AA (20 mg/Kg BW), a dose of  $AFB_1$  (15 or 30 I—g/Kg BW) without or with AA (20 mg/Kg BW).  $AFB_1$  resulted in decrease ( $P<0.05$ ) in DMI, the percentage decrease were 13.1 and 37.2%, respectively, for low and high doses. AA however, did not completely counteract the harmful effect of the high dose of  $AFB_1$  on DMI. Low and high doses of  $AFB_1$  showing 12.7 and 17.3% increase in water intake (WI), while addition

of AA to the low dose resulted in reduction of WI. Digestibility coefficients of DM, OM, CP and NFE were affected ( $P<0.05$ ) by treatment; AA caused slight improvement in the apparent digestibility coefficients. Digestible crude protein (DCP) was affected by treatment, the reduction was 3.3 and 13.8% for low and high groups. While TDN was not affected, AA did not counteract the deleterious effect of  $AFB_1$  on DCP and TDN. AA was not effective in minimizing the hazardous effect of  $AFB_1$  on nitrogen utilization.  $AFB_1$  caused significant increase in bladder weight only in the high dose group, but decreases in testes weight at both doses of  $AFB_1$ . AA had no significant effect on ladder, testes, liver or kidney overall mean weights. In conclusion, the exposure of animals to  $AFB_1$  even in small doses induces pronounced hazardous effect in several physio-metabolic functions. Using AA can preventing aflatoxicosis caused from contaminated feeds.

**Key words:** Aflatoxin, ascorbic acid, growth performance, rabbits, digestibility.

#### FEEDING RABBITS ON DIET CONTAMINATED WITH LINDANE, ZINC AND THEIR COMBINATION. 1- EFFECT ON GROWTH PERFORMANCE.

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The objective of the present study was to assess the potential effects of two chemical contaminants, lindane (HCH), zinc chloride ( $ZnCl_2$ ) and interactive of them on growth performance of rabbits. Twenty-four

male New Zealand White growing rabbits aged one month were randomly divided into 4 equal groups, on body weight basis, each treatment consists of 6 individual rabbits. Lindane and the combination of lindane and zinc treatment caused a significant decline ( $P<0.05$ ) in live body weight, performance index, dry matter intake, digestibility coefficients, nutritive value, nitrogen utilization, metabolizable energy (ME) compared to the control animals. While, treatment with zinc alone did not cause any effect on the above parameters, except caused a significant decrease in drinking water. Lindane and its combination with zinc treatment caused a significant increased ( $P<0.05$ ) in feed efficiency and drinking water. However, they caused a significant enlargement ( $P<0.05$ ) in the relative weights of liver, kidney, lung, spleen and heart. But brain, testes and bladder caused atrophy ( $P<0.05$ ) during treatment with lindane and their combination. There was marked ( $P<0.05$ ) decrease in carcass chemical composition (DM and CP), while, fat and ash were significantly ( $P<0.05$ ) increased.

**Key words:** Lindane, zinc, pesticide, rabbits, digestibility, nutritive value, nitrogen utilization, feed efficiency, growth.

#### PARTIAL REPLACEMENT OF SOYBEAN MEAL BY DRIED YEAST IN DIETS OF GROWING BOUSCAT RABBITS

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The present study was designed to

evaluate the dried brewer's yeast (*Saccharomyces cerevisiae*) as partial substitute for soybean meal in the diets of growing rabbits. Eighty weanling Bouscat rabbits (40 males + 40 females) with an average initial body weight  $612.5 \pm 12.01$  g were randomly allotted into four experimental groups based on body weight and sex. The control pelleted diet (Diet A) contained 20% soybean meal as a source of protein, while the other three diets contained 16 % SBM+ 4 % dried yeast (Diet B), 12% SBM + 8 % dried yeast (Diet C) and 8 % SBM + 12 % dried yeast (Diet D) where yeast were replaced 20 %, 40% and 60% of SBM, respectively. At the end of the experiment a metabolism trial was conducted by using 4 male rabbits from each treatment groups. At the end of the experimental period, 3 male rabbits from each dietary group were randomly taken for slaughter to study carcass traits and specimens of liver and kidneys were taken for the histopathological investigation. Blood sample was taken from each rabbit in the time of slaughter to study the effect of dietary treatment on biochemical changes in the blood serum components. The present results indicated that average of live body weight at 9 weeks of age, daily weight gain from 5-9 weeks and 5-13 weeks of age and feed conversion efficiency were higher ( $P < 0.05$  or  $P < 0.01$ ) in rabbits fed the dried yeast diets than the control. However, daily feed intake, and mortality percentages were not affected significantly by dietary inclusion of dried yeast. The rabbits fed Diet C (8% dried yeast) had the best values of growth performance, followed by those fed Diet B (4% dried yeast), Diet D (12% dried yeast) and Diet A (control), respectively. Digestibility of all nutrients and feeding values of the tested diets, were statistically similar. All carcass traits were not affected significantly by dietary inclusion of dried yeast, except the relative kidneys weight which was lower ( $P < 0.01$ ) in rabbit fed the yeast diets as compared with the control. Levels of blood serum albumin, creitinine,

AST and ALT were significantly ( $P < 0.05$  or  $P < 0.01$ ) higher in rabbits fed Diet D than in the control and other groups. However, levels of serum total protein, globulin, albumin /globulin ratio, triglyceride, cholesterol and uric acid were not affected significantly by the dietary treatments. An improvement in the economical efficiency (%) was recorded for rabbits fed diets containing different levels of dried yeast as compared with those fed the control diet.

**Key words:** Yeast diet, growth, blood components, economical efficiency.

EFFECTS OF VITAMINS A AND E  
SUPPLEMENTATION ON  
PERFORMANCE OF PRE AND POST-  
SEXUAL MATURITY OF MALE  
RABBITS, UNDER EGYPTIAN  
CONDITIONS

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Seventy-two weaned Californian male rabbits aged 5 weeks and 560.5g of body weight were used in the present study. The animals were divided into four equal groups (18 in each one). The first group was kept as control and fed a commercial diet. The

second, third and fourth groups were fed the same diet in the first group supplemented weekly with 400 IU Vit. A, 50mg Vit E and 400 IU Vit A plus 50mg Vit E/ Kg body weight, respectively. Growth performance, body thermoregulation, blood metabolites, scrotal circumference, libido, semen quality and fertility rate were estimated, during summer months. The results showed that daily feed intake and feed efficiency were significantly ( $P < 0.05$ ) higher in male rabbits fed vitamins than in control. Final weight, daily weight gain and scrotal circumference were insignificantly higher, while feed efficiency in male rabbits fed Vit. A plus E was significantly higher ( $P < 0.05$ ) than the other treated groups. Age at puberty, ear lobe temperature and rectal temperature were significantly ( $P < 0.05$ ) lower in the treated groups than the control group. Respiration rate and pulse rate in male rabbits fed Vit. A plus E were significantly ( $P < 0.05$ ) lower than in other groups. Total protein, albumin and testosterone concentrations in the treated buck groups were significantly ( $P < 0.05$ ) higher than in untreated group, however, globulin, A/G ratio and cholesterol concentrations did not differ due to treatments. Vit. A, Vit. E and Vit. A plus E supplementation improved significantly ( $P < 0.05$ ) libido and semen quality of rabbit bucks during summer months. Fertility rate was significantly ( $P < 0.05$ ) higher for does mated with Vit. A plus E treated bucks as compared to these mated with control bucks.

**Key words.** Rabbits, vitamins, heat stress, growth, semen, fertility.