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# EFFECTS OF INBREEDING ON GROWTH AND SLAUGHTER TRAITS OF RABBITS

## *EFEITO DA ENDOGAMIA EM CARACTERÍSTICAS DE CRESCIMENTO E ABATE DE COELHOS*

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## SUMMARY

Data from 1,512 Californian and 1,370 New Zealand White rabbits were analyzed by least squares procedures to study the effect of inbreeding of individuals, a covariate in the mathematical model, on body weights from weaning to slaughter and dressing percentage. Both linear and quadratic regression coefficients of inbreeding of rabbits were important for weights at several ages. Inbreeding of rabbits did not affect their performances at weaning and 5 weeks of age, but had an important effect on body weights measured from 6 to 11 weeks of age, with increases of performance from F=0 up to F=10% and reductions after that level. The effect of inbreeding was small on the weights observed at slaughter, and the trend was of reduction of weights when F increased. The same trend was observed for dressing percentage.

**UNITERMS:** Slaughter; Growth; Inbreeding; Rabbits

## INTRODUCTION

Although inbreeding is widely used in the rabbit industry, it's effects in this species are not as well known as in other farm animals. Reviews about the theory, concepts, effects, computing, importance and application of inbreeding on farm animals can be found in the literature (DICKERSON[3], 1972; BRINKS; KNAPP[2], 1975; FALCONER[4], 1981; GILLOIS[9], 1988; HARTL[10], 1989; WRAY; THOMPSON[22], 1990). In an extensive study about the effects of inbreeding on beef cattle performance, it was found a linear trend of decrease in performance for all growth traits with increased inbreeding and they concluded that inbreeding of dams was two times more important for performance of males than of females, probably because the larger growth potential of males is handicapped by reduction of milk production of inbred cows (BRINKS; KNAPP[2], 1975). Those authors considered that both linear and quadratic regression coefficients were important to measure the effect of inbreeding. Quadratic effects of inbreeding on rabbits performance were also significative in other studies (FERRAZ et al.[6], 1991 for reproductive traits; FERRAZ et al.[7], 1992 for growth traits).

DICKERSON[3] (1972) considered that inbreeding, in combination with individual and family selection in chickens, pigs, sheep and cattle and in sex limited traits, could increase predicted annual response, but concluded too that inbreeding also depresses performance, particularly in components of reproductive fitness, and in growth.

The effect of inbreeding on growth and carcass traits is not weel studied in rabbits and very few papers on this topic were found in the literature. MIROSHNICHENKO[16] (1974) worked with inbred lines of Grey Giant rabbits and found a significant effect of inbreeding at 120 and 240 days of age, when the inbred animals had the lightest weights, but not in individual weight at 30 days. Another study with inbred lines of French Silver rabbits did not find differences of inbred lines when compared with non inbred animals on body weights at 56 and 112 days of age (ZELNIK; GRANAT[24], 1973). ZELNIK[23] (1984) found significant decreases on body weights at 56 and 168 days of age in Nitra rabbits, with the increase of inbreeding coefficients, while other authors didn't find statistical differences among 90 day body weights of inbred and control lines of Soviet Chinchilla rabbits (MIROS et al.[14, 15], 1987).

A study that analysed the effect of inbreeding on some traits of Angora rabbits found lighter inbred animals at 2, 4 and 7 months of age, when compared with non inbred ones (PARK et al.[20], 1990).

NUNES and POLASTRE[17] (1988) analysed the effects of inbreeding on reproductive performance of Norfolk hibrid rabbits and did not find any significant effect of inbreeding on litter size or percentage stillborn. NUNES and POLASTRE[18] (1990) did not find effects of inbreeding on growth traits and the same authors also did not find effects of inbreeding on traits measured at slaughter (NUNES; POLASTRE[19], 1990). However, those effects were found significative in a similar study realized by FERRAZ et al.[6] (1991) in Californian and New Zealand White rabbits, being linear and quadratic effects considered important.

The objective of this study was to evaluate the effect of inbreeding on individual body weights from weaning to slaughter, on weights observed at slaughter and on dressing percentage in Californian and New Zealand White rabbits raised in a subtropical area of Brazil.

## MATERIAL AND METHOD

The data were collected from 2882 weaned Californian and

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New Zealand White rabbits, born from September 1988 to December 1990, at the Rabbit Research Sector of the University of São Paulo, campus of Pirassununga, state of São Paulo, Brazil. Those facilities are located approximately at 22°S and 47°W and 750 m above the sea level, where average temperatures go from 15°C (59°F) in winter time up to 30°C (86°F) in summer time. The animals were housed in a closed building with lateral openings, where the internal temperatures varied from 18°C (64.5°F) to 35°C (95°F). The distribution of data according to breed, sex and inbreeding intervals is shown in Tab.1.

At weaning, that occurred in an average of 28 days, rabbits were identified by tattooing and their numbers, sex and weights recorded. After weaning, the animals were raised in confinement, grouped with their littermates, in metallic cages (85 x 95 x 45 cm), with automatic waterers and feeders. A commercial pelleted feed (minimum of 18% crude protein and 17% fiber guaranteed), plus 20% supplementation with green elephant grass or rami was supplied.

All the animals were weighed weekly, from weaning to 11 weeks at age, generating individual weights at weaning (IWW), and from 5 to 11 weeks (IW5, IW6, IW7, IW8, IW9, IW10, IW11).

Slaughter of the animals occurred at 87 days as an average, and at that time individual weight at slaughter (IWSL), carcass weight (CWT) - warm washed carcass, without head, skin and viscera-, viscera weight (VISWT) - all the internal organs, including the gastro-intestinal content, head weight (HEADWT) - head with ears and head skin, eyes and brain, plus the hands, feet and tail, used in crafts - and skin weight (SKINWT) were measured. Dressing percentage (DRESSING) was considered as the ratio CWT/IWSL and the transformed scale (arcsin $(\text{DRESSING})^{1/2}$) was used in analysis to approximate normality (GILL[8], 1978).

The coefficients of inbreeding for each animal (F), were calculated using FENRM program (an adaptation of K. Meyer's program, (MEYER[12,13], 1988), made by VAN VLECK, 1990)* and DFNRM program (MEYER[12,13], 1988 modified by BOLDMAN, 1991)**, using all the pedigree information available since the foundation of the herd (BOLDMAN; VAN VLECK[1], 1991; MEYER[12,13] 1988). The data were analysed by a Least Squares Analysis, Fixed Model using SAS program-GLM procedure (SAS INSTITUTE[21], 1985). The mathematical model was:

$$Y_{ijklmn} = u + A_i + B_j + P_k + Y_l + S_m + YS_{lm} + b_1(F-MF) + b_2(F-MF)^2 + FA_i + FB_j + FY_l + b_3(\text{age-mage}) + b_4(LSW-MLSW) + b_5(LSW-MLSW)^2 + E_{ijklmn},$$ where:

$Y_{ijklmn}$ = observed trait on the nth rabbit;
$u$ = overall least squares mean;
$A_i$ = fixed effect of the ith sex (i=1,2);
$B_j$ = fixed effect of the jth breed (j = 1,2);
$P_k$ = fixed effect of the kth parity of the doe (k = 1,..., 18);
$Y_l$ = fixed effect of the lth year (l=1988, 1989 and 1990);
$S_m$ = fixed effect of the mth season (m = 1, 2, 3, 4, );
$YS_{lm}$ = fixed effect of the interaction of the lth year and the mth season, with 2 missing subclasses (seasons 1 and 2 of 1988);
$b_1$ and $b_2$ = linear and quadratic regression coefficients for inbreeding of animals (F);
MF = mean inbreeding of animals;
$FA_i$ = effect of interaction between inbreeding (F) and the ith sex;
$FB_j$ = effect of interaction between inbreeding (F) and the jth breed;
$FY_l$ = effect of interaction between inbreeding (F) and the lth year;
$b_3$ = overall linear regression coefficient for age at slaughter (age), used only for traits measured at that time;
mage = mean age at slaughter ( 87 days)
$b_4$ and $b_5$ = linear and quadratic regression coefficients for adjustment of data for litter size at weaning (LSW);
MLSW = mean litter size at weaning;
$E_{ijklmn}$ = the random error, N $(0, \sigma^2)$

The significance of the effects were tested at the level of $P<0.05$ (*) and $P<0.01$ (**) with the F statistic.

## RESULTS AND DISCUSSION

The number of observations, means, standard errors and range for each variable analysed and for individual inbreeding is shown in Tab.2 while Tab.3 presents the statistical significance level of the effects for each trait.

The effects of breed, sex, parity, year, season, age at slaughter and litter size at weaning on growth and carcass traits on this data set were analysed and discussed by FERRAZ et al.[5] (1991).

The effect of inbreeding of animals on growth traits, shown in Tab.3, was not statistically significant for traits observed at weaning and at 5 weeks of age, but was a very important source of variation for the individual weights measured from 6 weeks (P<0.05 for linear and quadratic effects) up to 11 weeks.

Linear regression coefficients were statistically significant (P<0.05) for IW6 and IW8 and at P<0.01 for IW7, IW8, IW9, IW10 and IW11, while quadratic regression coefficients were significant at P<0.05 only for IW6 and at P<0.01 for IW7 up to IW11. Thus, when studying the effects of inbreeding, both linear and quadratic regression coefficients must be considered, as reported by BRINKS; KNAPP[2] (1975) and FERRAZ et al.[6] (1991).

The importance of inbreeding effects in growth and carcass traits found in this study agree with the results of some authors (FERRAZ et al.[7], 1992; MIROS et al.[14,15], 1987; ZELNIK[23], 1984), but are different than those reported by ZELNIK and GRANAT[24], (1973) and NUNES; POLASTRE[18] (1990), that worked with similar levels of inbreeding, similar models and also used data from the same region of Brazil.

* VAN VLECK, L. D. Unpublished program. Personal communication. Lincoln, University of Nebraska, 1990.
** BOLDMAN, K. G. Unpublished modification. Personal communication. Lincoln, University of Nebraska, 1991.

The inbreeding by breed interaction, caused by the different levels of inbreeding within each breed, with higher levels on Californian rabbits, as shown in Tab.2, was expected for all traits, but the statistical significance (P<0.05) was observed only for IWW.

The levels of inbreeding in the three different years varied in Californian rabbits from 0.03040 in 1988 to 0.05212 in 1990 and from 0.02237 to 0.03487 in New Zealand White animals. This interaction (inbreeding by year) is presented in Tab.3 and also in Fig.1, and affected only IW9 (P<0.05) and was not an important source of variation for all other traits, maybe because of the moderate level of inbreeding observed in this herd. However, in closed herds, that have the tendency of increase the inbreeding levels, this interaction must be considered and can be very important.

The interaction of inbreeding with sex, described in cattle (BRINKS; KNAPP[2], 1975) was not found here in any variable. This interaction may not be important for rabbits, probably because of the almost identical growth performance of male and female rabbits, as discussed previously by FERRAZ et al.[5] (1991). The linear and quadratic regression coefficients are shown in Tab.4 and the equations with the changes in performance of animals due to inbreeding were plotted in Fig. 2 to 4.

The effect of inbreeding on IWW, IW5, IW6 and IW7 is presented in Fig.2. The effect was very small and non significant on IWW and IW6, with variation of + or - 20 g in those weights when inbreeding varied from 0 to 25%, which is a change of only 3.6% in IWW and 2.6% in IW6. The effects observed in IW7 and IW8 are much higher and their trends are similar for both traits. An increase of the performance of animals was observed when inbreeding coefficient increased from 0 to about 10% and a severe reduction on those weights occurred with levels of inbreeding larger than 10%. This effect could have been caused either by sample error, as the sample analysed had an average F for inbred animals of 6.3% and for all animals of 3.3% or could be the result of selection, as the animals in this sample were selected for body weight. Selection might offset the effects of inbreeding depression, particularly at low levels of inbreeding. Further studies on the genetic trend on these traits could help to clarify those hypothesis.

The same trends were observed in IW8, IW9, IW10 and IW11, as shown in Fig.3. For those traits, the trend was very similar for IW8, IW9 and IW11, with increasing weights when F levels varied from 0 to about 10% and severe reduction after that. The trend observed in IW10, the weight used as criteria to select animals, was similar, but the effect was bigger and the point of reversion of trend was not 10% of F, but about 15%. This observation suggests some confouding of the effects of inbreeding and selection. Analysis of genetic trend should clarify this. Another possible cause of the observed increasing performance at lower levels of inbreeding should be that selection and inbreeding at those levels could have selected for homozigozity of favorable alleles in some loci. The utility of uses of inbreeding and selection was discussed by several authors, as DICKERSON[3] (1972) and HOHENBOKEN et al.[11] (1992).

The effect of inbreeding on the traits observed at slaughter, that was statistically significant (P<0.05) only for the quadratic regression coefficients for IWSL, CWT and HEADWT, is shown in Fig.4. In those traits, that were not submited to selection, inbreeding depressed severely the performance of animals. The reduction in IWSL and CWT was very small for inbreeding levels as high as 10%, but increased very fast after that level, reaching decreases of about, respectively, 11.1 and 13.7% of the mean weights at the level of F of 25%.

The effect of inbreeding on dressing percentage was very small and non significant, and the trend, shown in Fig.5, is of reduction in percentage with high levels of inbreeding, with values close do 0.5% of reduction with level of inbreeding of 10% and 2% for F=25%. Although those values were not statistically significant, this reduction can be very important in the rabbit industry, as it reduces the industrial yield.

## CONCLUSIONS

It can be concluded that:

1) Inbreeding of rabbits did not affect their performances at weaning and 5 weeks of age;

2) Inbreeding of rabbits had an important effect on body weights measured from 6 to 11 weeks of age, with increases in performance from F=0 up to F=10% and reductions after that level. For IW10, the point where the trend reversed was F=15%;

3) Linear and quadratic regression coefficients are important to explain the effect of inbreeding on growth and carcass traits;

4) Inbreeding had a small effect on weights observed at slaughter, and the trend was of reduction of weights when F increased. The same trend was observed for dressing percentage.

## RESUMO

Os pesos individuais semanais da desmama ao abate de 2.882 coelhos, sendo 1.512 da raça Califórnia e 1.370 da raça Nova Zelândia Branca foram analisados pelo método dos quadrados mínimos para verificação dos efeitos da endogamia, uma covariável no modelo matemático, no desempenho desses animais. Tanto os efeitos lineares quanto quadráticos da endogamia dos coelhos foram importantes para pesos individuais a diversas idades. A endogamia dos coelhos não afetou seu desempenho à desmama (realizada em média aos 28 dias) e nem às cinco semanas de idade, mas afetou significativamente os pesos corporais de 6 a 11 semanas, com aumentos de pesos para endogamia variando de 0 a 10% e diminuições do desempenho após este nível. Nas características de carcaça e abate, o efeito foi pequeno, com uma tendência geral de decréscimo com o aumento do coeficiente de endogamia, o mesmo sendo verificado com o rendimento de carcaça. Estes resultados demonstram a importância do controle dos níveis de endogamia em coelhos, pois, mesmo quando mantidos abaixo dos 10%, podem afetar significativamente o desempenho produtivo.

**UNITERMOS:** Abate; Crescimento; Endogamia; Coelho

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TABLE 1
Number of observations per breed of individual weights from weaning to slaughter and some slaughter traits and distribution according to inbreeding intervals of 2,882 Californian and New Zealand White rabbits raised in a subtropical area of Brazil. Pirassununga - SP, September 1988 to December 1990.

| Variable or interval | Californian | New Zealand White | Total |
|---|---|---|---|
| IWW | 1,512 | 1,370 | 2,882 |
| IW5 | 1,423 | 1,313 | 2,736 |
| IW6 | 1,329 | 1,212 | 2,541 |
| IW7 | 1,296 | 1,118 | 2,414 |
| IW8 | 1,237 | 1,110 | 2,347 |
| IW9 | 1,213 | 1,086 | 2,299 |
| IW10 | 1,181 | 1,070 | 2,251 |
| IW11 | 1,115 | 1,030 | 2,145 |
| IWSL | 908 | 823 | 1,731 |
| CWT | 908 | 823 | 1,731 |
| VISWT | 908 | 823 | 1,731 |
| HEADWT | 908 | 823 | 1,731 |
| SKINWT | 908 | 823 | 1,731 |
| DRESSING | 908 | 823 | 1,731 |
| Inbreeding of animals | | | |
| overall mean | 0.041 | 0.024 | 0.033 |
| # of non inbred animal | 545 | 842 | 1,387 |
| # of inbred animals | 967 | 528 | 1,495 |
| mean of inbred animals | 0.063 | 0.062 | 0.063 |
| maximum inbreeding | 0.281 | 0.250 | 0.281 |
| # of animals/interval of inbreeding | | | |
| 0.000 < F ≤ 0.025 | 291 | 119 | 410 |
| 0.025 < F ≤ 0.050 | 200 | 166 | 366 |
| 0.050 < F ≤ 0.075 | 176 | 91 | 267 |
| 0.075 < F ≤ 0.100 | 150 | 43 | 193 |
| 0.100 < F ≤ 0.125 | 39 | 64 | 103 |
| 0.125 < F ≤ 0.150 | 17 | 12 | 29 |
| 0.150 < F | 94 | 33 | 127 |

IW = individual weight; W = weaning; 5,6,....11 = number of weeks where the weights were measured; SL = slaughter; CWT = carcass weight; VISWT = weight of viscera; HEADWT = weight of head plus hands, feet and tail; SKINWT = skin weight; DRESSING = dressing percentage.

TABLE 2
Number of observations (N), mean (MEAN), standard error (SE), minimum and maximum for variables analysed in growth and carcass traits and inbreeding (F) of Californian and New Zealand rabbits raised in Brazil. Pirassununga - SP, September 1988 to December 1990.

| Variable | N | MEAN | SE | MINIMUM | MAXIMUM |
|---|---|---|---|---|---|
| IWW,g | 2,882 | 554.93 | 2.76 | 85.00 | 995.00 |
| IW5,g | 2,736 | 772.60 | 3.66 | 120.00 | 1,450.00 |
| IW6,g | 2,541 | 1,004.58 | 4.55 | 180.00 | 1,750.00 |
| IW7,g | 2,414 | 1,231.76 | 5.42 | 300.00 | 2,150.00 |
| IW8,g | 2,347 | 1,459.28 | 5.93 | 220.00 | 2,450.00 |
| IW9,g | 2,299 | 1,682.20 | 6.31 | 460.00 | 2,680.00 |
| IW10,g | 2,251 | 1,904.40 | 6.60 | 480.00 | 3,050.00 |
| IW11,g | 2,145 | 2,106.87 | 6.75 | 900.00 | 3,300.00 |
| IWSL,g | 1,731 | 2,251.88 | 8.51 | 900.00 | 3,450.00 |
| CWT,g | 1,731 | 1,170.01 | 4.93 | 365.00 | 1,890.00 |
| VISWT,g | 1,731 | 484.61 | 1.82 | 215.00 | 765.00 |
| HEADWT,g | 1,731 | 284.38 | 1.01 | 135.00 | 615.00 |
| SKINWT,g | 1,731 | 270.39 | 1.40 | 85.00 | 520.00 |
| DRESSING,% | 1,731 | 51.81 | 0.07 | 40.34 | 65.61 |
| F | 2,882 | 0.033 | 0.001 | 0.000 | 0.281 |

IW = individual weight; W = weaning; 5,6,....11 = number of weeks where the weights were measured; SL = slaughter; CWT = carcass weight; VISWT = weight of viscera; HEADWT = weight of head plus hands, feet and tail; SKINWT = skin weight; DRESSING = dressing percentage; F = coefficient of inbreeding.

TABLE 3

Probabilities of values greater than F (P>F) for the fixed effects breed (BRD), sex (SEX), parity of doe (PAR), year (Y), season (S), interaction between year and season (Y*S), linear and quadratic effects of inbreeding [F(l) and F(q)] and age at slaughter (AGE) in growth and carcass traits of Californian and New Zealand White rabbits raised in a subtropical area of Brazil. Pirassununga-SP, September 1988 to December 1990.

| EFFECT>> TRAIT | BRD | SEX | PAR | Y | S | Y*S | F(l) | F(q) | F*BRD | F*SEX | F*Y | AGE | LS(l) | LS(q) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IWW | .0020 | .1417 | .0001 | .0001 | .0001 | .0001 | .4931 | .4353 | .0298 | .7738 | .1595 | - | .0237 | .0276 |
| IW5 | .0326 | .4332 | .0001 | .0001 | .0001 | .0001 | .2963 | .5446 | .2219 | .9717 | .6744 | - | .8438 | .0001 |
| IW6 | .0137 | .8214 | .0001 | .0001 | .0001 | .0001 | .0134 | .0210 | .1392 | .8195 | .2032 | - | .7421 | .0003 |
| IW7 | .0320 | .9050 | .0002 | .0001 | .0001 | .0001 | .0052 | .0014 | .2719 | .9796 | .1303 | - | .8604 | .0010 |
| IW8 | .0832 | .5409 | .0001 | .0001 | .0001 | .0001 | .0115 | .0022 | .5744 | .4948 | .5396 | - | .5747 | .0004 |
| IW9 | .2297 | .9725 | .0001 | .0001 | .0001 | .0001 | .0069 | .0022 | .3506 | .6834 | .0493 | - | .4122 | .0450 |
| IW10 | .8667 | .5135 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .9379 | .7861 | .2534 | - | .4129 | .0419 |
| IW11 | .2844 | .6074 | .0001 | .0001 | .0001 | .0001 | .0062 | .0057 | .7591 | .7587 | .8731 | - | .6649 | .0198 |
| IWSL | .8081 | .5699 | .0001 | .0001 | .0262 | .1192 | .1106 | .0301 | .8040 | .2662 | .4735 | .0001 | .5032 | .1608 |
| CWT | .5496 | .2893 | .0003 | .0001 | .0036 | .0006 | .2166 | .0334 | .6785 | .1905 | .5882 | .0001 | .6673 | .0317 |
| VISWT | .8975 | .0030 | .0001 | .1490 | .0001 | .0001 | .1772 | .1645 | .2823 | .4865 | .6405 | .0001 | .2691 | .5113 |
| HEADWT | .5807 | .0001 | .0422 | .0001 | .0023 | .0001 | .0873 | .0368 | .6487 | .3915 | .5349 | .0001 | .4833 | .3621 |
| SKINWT | .1435 | .8767 | .0064 | .0001 | .0001 | .0001 | .5883 | .3922 | .6473 | .3886 | .9769 | .0001 | .0526 | .9318 |
| DREESSING | .4343 | .2854 | .0815 | .0026 | .0001 | .0001 | .4933 | .5042 | .8002 | .0899 | .4890 | .0001 | .0011 | .0027 |

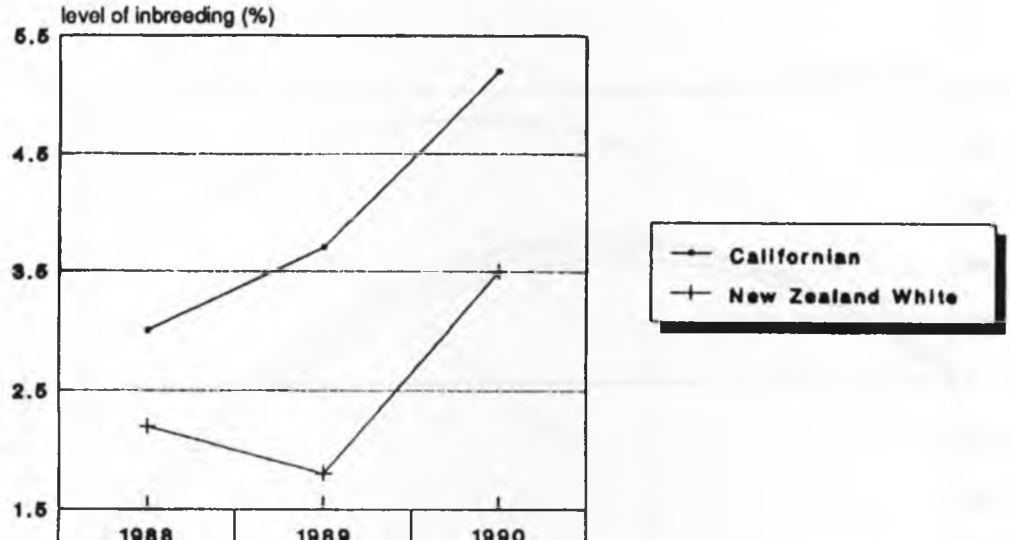
IW = individual weight; W = weaning; 5,6,....11 = number of weeks where the weights were measured; SL = slaughter; CWT = carcass weight; VISWT = weight of viscera; HEADWT = weight of head plus hands, feet and tail; SKINWT = skin weight; DRESSING = dressing percentage.

TABLE 4

Linear and quadratic regression coefficients for inbreeding [F(l) and F(q)] for growth and slaughter traits observed in Californian and New Zealand White rabbits raised in a subtropical area of Brazil. Pirassununga-SP, September 1988 to December 1990.

| TRAIT | F(l) | F(q) |
|---|---|---|
| IWW | 50.832482 | -522.469485 |
| IW5 | 205.120368 | -545.134913 |
| IW6 | 515.957175 | -2,602.639086 |
| IW7 | 700.353883 | -4,373.451854 |
| IW8 | 878.047794 | -4,568.236296 |
| IW9 | 982.681834 | -4,852.084947 |
| IW10 | 1,309.222443 | -8,079.871183 |
| IW11 | 939.123502 | -4,729.136810 |
| IWSL | 122.449606 | -4,511.572260 |
| CWT | -9.088424 | -2,551.317059 |
| VISC | 18.021075 | -669.819778 |
| HEAD | 38.407142 | -501.806081 |
| SKIN | 12.571696 | -291.519171 |
| DRESSING | -0.043465 | -0.120265 |

IW = individual weight; W = weaning; 5,6,....11= number of weeks where the weights were measured; SL = slaughter; CWT = carcass weight; VISWT = weight of viscera; HEADWT = weight of head plus hands, feet and tail; SKINWT = skin weight; DRESSING = dressing percentage.




| | 1988 | 1989 | 1990 |
|---|---|---|---|
| Californian | 3 | 3.7 | 5.2 |
| New Zealand White | 2.2 | 1.8 | 3.5 |

year

FIGURE 1
Changes in levels of inbreeding of data from Californian and New Zealand White rabbits*.
* raised in Pirassununga, SP

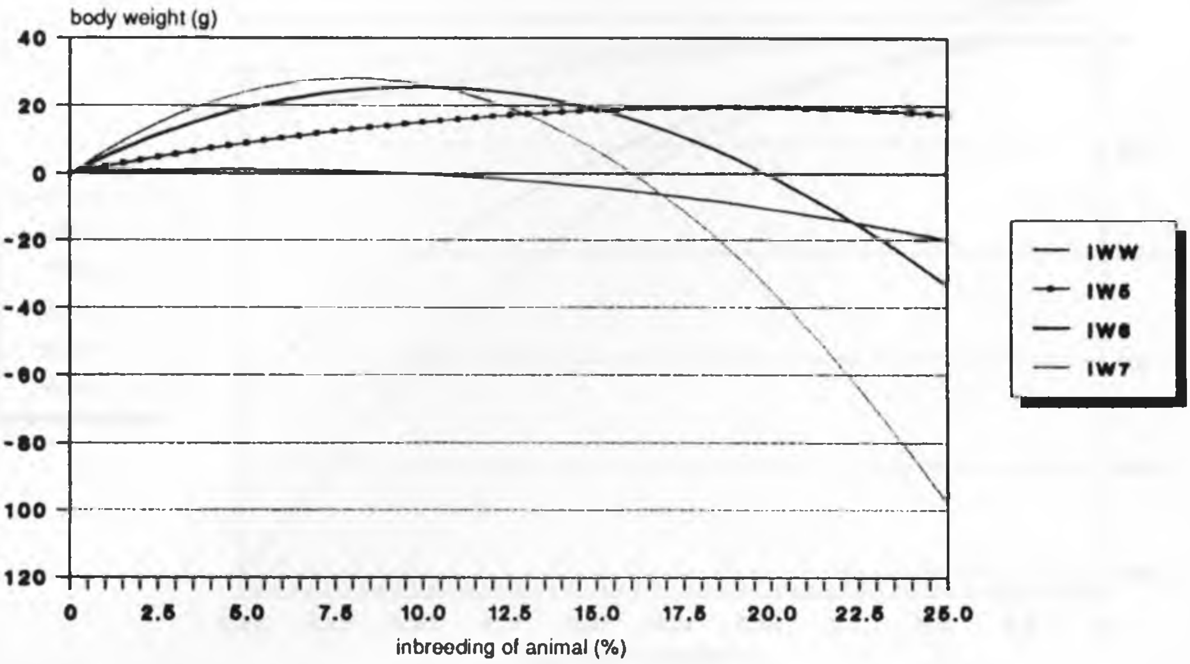



FIGURE 2
Deviations of body weights at weaning, 5, 6 and 7 weeks of age of rabbits, due to inbreeding of animals*.
* Californian and New Zealand White, raised in a subtropical area of Brazil

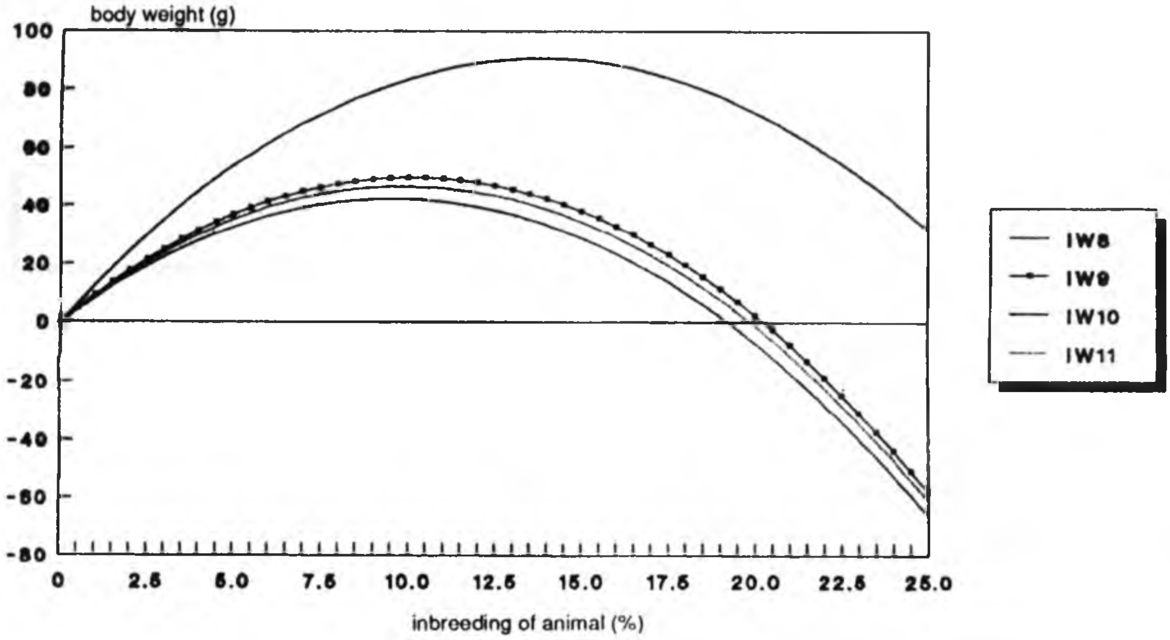



FIGURE 3
Deviations of body weight at 8, 9, 10 and 11 weeks of age due to inbreeding of rabbits*.
* Californian and New Zealand White, raised in a subtropical area of Brazil

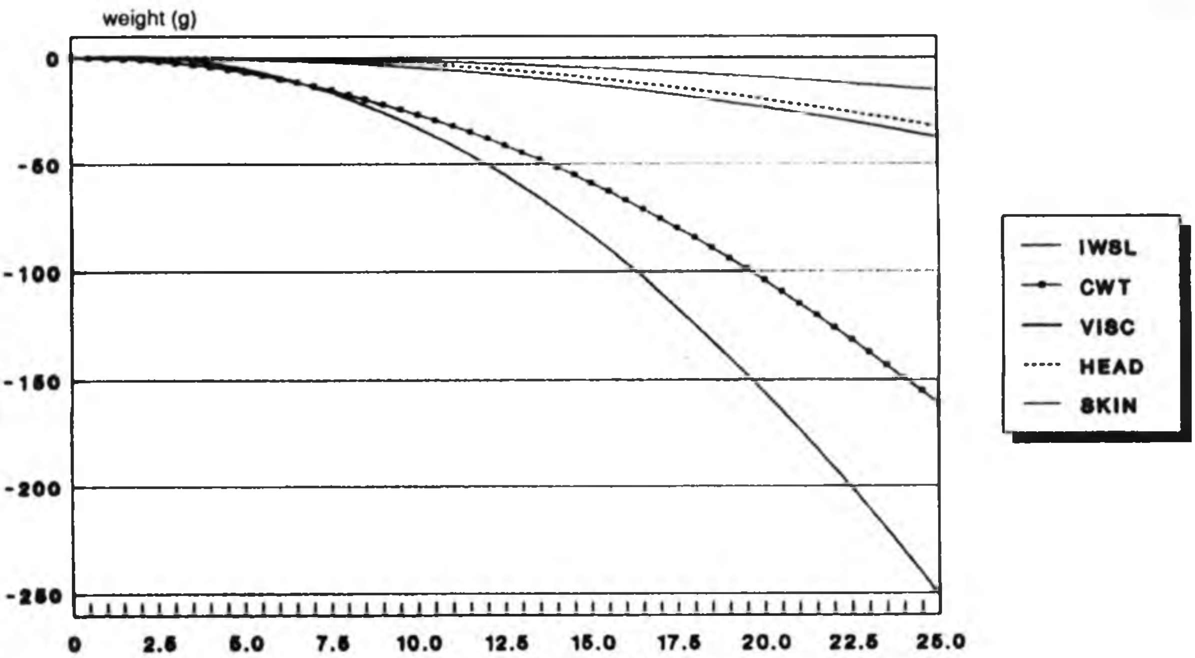



FIGURE 4
Deviations of weights observed at slaughter in Californian and New Zealand White rabbits*, due to inbreeding.
* raised in a subtropical area of Brazil

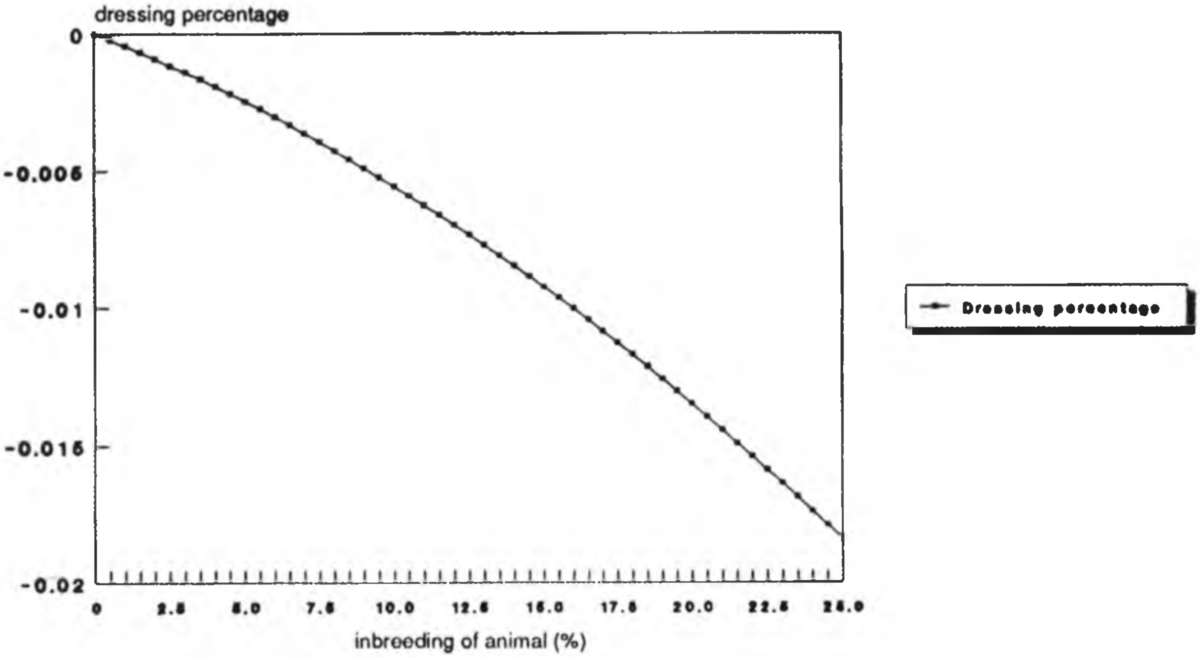



FIGURE 5
Reduction on dressing percentage of Californian and New Zealand White rabbits, due to inbreeding.
(animals raised in a subtropical area of Brazil)