Proceedings 3rd World Rabbit Congress, 4-8 April 1984, Rome – Italy, Vol. 2, 585-594

USING REGRESSION EQUATIONS TO DETERMINE THE MEAT, BONE AND FAT CONTENT OF WHITE NEW ZEALAND RABBIT CARCASSES

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Introduction

Rabbit breeding in recent years has been concerned not only with production numbers but also with meat quality. Carcass quality is determined primarily by the quantity of meat, fat and bone. Detailed carcass dissection gives exact information, however it is impractical since it is very time consuming.

The purpose of the following experiment was to determine the applicability of some feeding and carcass parameters to determine carcass meat, fat and bone content as well as using regression equations to analyze the quality of the above mentioned parameters in rabbit carcasses.

Materials and Methods

The study was carried out on 404 White New Zealand rabbits. At the end of fattening the rabbits were slaughtered after a 24-hour fast. The carcasses were cooled for 24 hours at 2 - 4°C. The cooled carcasses were divided into three parts: front part, loin and hind part /Niedźwiadek, 1974/, after which a detailed dissection was done to separate the meat, fat and bones.

Statistical analysis of the parameters under study was done on the basis of arithmetic means, and variation coefficients. The basis for choosing parameters for the regression equation was the correlation co-

efficient calculated between the amount of meat, fat and bone in the carcass and the parameters taken into consideration in the study. In calculating the equations only those were considered for which the standard error /S_y/ was the lowest and which had the highest multiple correlation coefficient /R/ between the determined and actual /dissected/ amount of meat, fat and bone in rabbit carcasses.

Results

As can be seen in Table 1 the weight of rabbits before slaughter was 2276 g, while carcass weight was 1123 g. Analysis of the variation coefficients for individual parameters, calculated for females, males and for both sexes together showed the greatest variation in parameters describing carcass fat, in loin /v = 59,4%/, in hind part /v = 45,8%/ and in the total carcass /v = 45,9%/. The greatest variation for both sexes in meationess was found in the meat weight of the loin. Also in this part, bone weight showed the greatest variability /v = 25,1%/. In all of the studied parameters the difference between the means for the sexes was statistically insignificant.

Table 2 presents correlation coefficients between the studied parameters and the meat, bone and fat quantity for both sexes. As can be seen carcass meatiness is in high correlation with carcass weight /r = 0,901/. The highest carcass meat correlation occurred with the amount of meat in the hind part /r = 0,960/. Much information about carcass meatiness can be obtained on the basis of carcass weight; the correlation coefficient is high /0,840/.

The highest correlation coefficient /0,711/ obtained for bone weight in the hind part /r = 0,867/. Fat weight in the carcass had the highest correlation for the loin. Lower coefficients were found for the weight before slaughter and carcass weight, which were 0,554 and 0,597, respectively.

Table 3 show simple regression equations for determining meat, bone and fat. In the instance of simple regression equations greater

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perciseness was found for meat and bone in the hind parts. For fat, the lowest evaluation error was obtained on the basis of loin weight.

More exact calculation of meat, bone and fat was oberved with multiple regression equations, with larger independent variables /Tab. 4/. The most exact equations contained: weight of rabbit before slaughter, carcass weight, carcass lenght, weight of hind part and meat weight in hind part /$R = 0{,}973$, $S_y = 28$ g/. Similary, in the instance of bone weight in the carcass equations with 4 and 5 independent variables proved to be more precise with $R = 0{,}877$ and $S_y = 9$ g. Preciese determination of carcass fat increased relatively little even with 4 and 5 independent variables.

Discussion

Dissection is too expensive and time consuming and therefore in practice regression equations are used in which easily measured parameters are used. This study used White New Zealand rabbits, a popular breed /Herman, 1963; Scheelje et al., 1967/. Meat, bone and fat content of rabbit carcasses slaughtered at 90 days of age were determined. The animals were fattened according to standard rabbit production methods /Kopański, 1977/.

An insignificant difference between sexes in the studied parameters made it possible to use a regression equation for both sexes together. More precise meat determination and fat carcass content in the case of the simple regression equations was obtained when the weight of these parameters in the hind part were used as independent variables. Greater preciseness was obtained using 4 and 5 independent variables in the multiple regression equation. To obtain this exactness it is necessary to dissect the hind parts. The regression equation used for determining meat and bone content made relatively precise calculations possible, thus significantly saving time on dissection of the entire carcass, as done to date.

The simple and multiple regression equations formula-

ted for calculating fat content of the carcass are not very precise. The is due to the high variability of this parameter in rabbits. It should be noted that rabbit carcasses have a small amount of easily digested fat. In production of young animals fattening does not play an important role /Kawińska et al., 1975; Scheelje et al., 1967/.

On the basis of the results obtai-ned from calculating meat and bone in White New Zealand rabbit carcasses weighing 2000 - 2600 g the following equations can be recommended:

for meat content:

$Y_1 = 0{,}240x_1 + 3{,}635x_2 - 0{,}255x_3 + 1{,}895x_4 - 69{,}8$ /R = 0,973; S_y = 28 g/

where: x_1 = carcass weight /g/, x_2 = carcass lenght /cm/, x_3 = weight of hind part /g/, x_4 = meat weight of hind part /g/.

for bone content in the carcass:

$Y_2 = 0{,}001x_1 + 1{,}411x_2 + 0{,}016x_3 + 1{,}898x_4 - 30{,}5$ /R = 0,877; S_y = 9 g/

where: x_1, x_2, x_3 - as above, x_4 - bone weight of hind part /g/

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Arithmetic means /$\bar{x}$/ and variation coefficients /v/ for slaughter and meat traits of rabbits

Traits	Females		Males		Total	
	$\bar{x}$	v	$\bar{x}$	v	$\bar{x}$	v
Weight of rabbit before slaughter /g/	2263	11,2	2289	10,7	2276	11,0
Weight of carcass /g/	1116	13,5	1132	12,6	1123	13,1
Length of carcass /cm/	33,6	5,5	33,7	5,2	33,6	5,3
Weight of front part /g/	402	14,2	417	13,5	409	13,9
Weight of loin /g/	263	18,5	266	18,2	265	18,3
Weight of hind part /g/	424	14,1	429	13,1	426	13,6
Weight of meat in loin /g/	208	17,6	213	16,7	210	17,2
Weight of bone in Loin /g/	17	25,1	17	25,1	17	25,1
Weight of fat in loin /g/	18	59,6	19	59,4	19	59,4
Weight of meat in hind part /g/	345	15,1	352	14,1	348	14,6
Weight of bone in hind part /g/	60	13,1	60	12,8	60	13,0
Weight of fat in hind part /g/	13	43,0	12	48,1	13	45,8
Weight of meat in carcass /g/	861	14,4	887	13,3	874	13,9
Weight of bone in carcass /g/	139	14,4	139	13,7	139	14,0
Weight of fat in carcass /g/	75	45,3	71	46,4	73	45,9

Correlation coefficients between weight of meat, bone and fat in carcass and slaughter and carcass traits

Traits	Weight of meat in carcass	Weight of bone in carcass	Weight of fat in carcass
Weight of rabbit before slaughter	0,840^{xx}	0,625^{xx}	0,554^{xx}
Weight of carcass	0,901^{xx}	0,620^{xx}	0,597^{xx}
Length of carcass	0,637^{xx}	0,561^{xx}	0,435^{xx}
Weight of front part	0,918^{xx}	0,711^{xx}	0,600^{xx}
Weight of loin	0,863^{xx}	0,525^{xx}	0,725^{xx}
Weight of hind part	0,918^{xx}	0,664^{xx}	0,499^{xx}
Weight of meat in loin	0,905^{xx}	0,539^{xx}	0,524^{xx}
Weight of bone in loin	0,455^{xx}	0,649^{xx}	0,202^{xx}
Weight of fat in loin	0,460^{xx}	0,179^{xx}	0,688^{xx}
Weight of meat in hind part	0,960^{xx}	0,626^{xx}	0,471^{xx}
Weight of bone in hind part	0,652^{xx}	0,867^{xx}	0,254^{xx}
Weight of fat in hind part	0,426^{xx}	0,251^{xx}	0,631^{xx}

xx - $P \leqslant 0,01$

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Simple regression equations for estimation of meat, bone and fat content in carcass of rabbits

Traits	Equations	Standard error of estimation /S_y/
Regression equations for content of meat		
Weight of rabbit before slaughter /g/	Y = 0,409x - 56,6	66
Weight of carcass /g/	Y = 0,754x + 28,5	51
Weight of front part /g/	Y = 1,960x + 71,0	49
Weight of hind part /g/	Y = 1,931x + 50,3	49
Weight of meat in hind part /g/	Y = 2,297x + 73,2	34
Regression equations for content of bones		
Weight of rabbit before slaughter /g/	Y = 0,049x + 27,4	15
Weight of carcass /g/	Y = 0,082x + 46,8	15
Weight of front part /g/	Y = 0,243x + 39,3	14
Weight of hind part /g/	Y = 0,223x + 43,8	14
Weight of bone in hind part /g/	Y = 2,167x + 8,7	10
Regression equations for content of fat		
Weight of carcass /g/	Y = 0,137x - 80,2	27
Weight of front part /g/	Y = 0,354x - 71,5	27
Weight of loin /g/	Y = 0,503x - 59,7	23
Weight of fat in loin /g/	Y = 2,052x + 34,7	24
Weight of fat in hind part /g/	Y = 3,634x + 27,1	26

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Multiple correlation coefficients and multiple regression equations for estimation of meat, bone and fat content in carcass of rabbits

Variables $x_1x_2x_3x_4x_5$	Multiple correlation coefficients /R/	Multiple regression equation	Standard errors of estimation /S_y/
		Regression equations for content of meat	
A B C	0,944	$Y_1 = -0,056x_1 + 0,457x_2 + 1,131x_3 + 24,9$	40
B C E G	0,953	$Y_1 = 0,468x_1 + 0,798x_2 - 0,623x_3 + 2,238x_4 + 15,9$	37
B C F H	0,973	$Y_1 = 0,240x_1 + 3,635x_2 - 0,255x_3 + 1,895x_4 - 69,8$	28
A B C F H	0,973	$Y_1 = -0,005x_1 + 0,248x_2 + 3,707x_3 - 0,256x_4 + 1,894x_5 - 69,9$	28
		Regression equations for content of bones	
A B D	0,718	$Y_2 = 0,023x_1 - 0,036x_2 + 0,242x_3 + 27,8$	13
B C E J	0,779	$Y_2 = 0,062x_1 + 2,128x_2 - 0,083x_3 + 2,164x_4 - 18,1$	12
B C F K	0,877	$Y_2 = 0,001x_1 + 1,411x_2 + 0,016x_3 + 1,898x_4 - 30,5$	9
A B C F K	0,877	$Y_2 = 0,004x_1 - 0,005x_2 + 1,361x_3 + 0,018x_4 + 1,887x_5 - 31,4$	9
		Regression equations for content of fat	
A B E	0,728	$Y_3 = 0,009x_1 - 0,035x_2 + 0,557x_3 - 55,2$	23
A B C E	0,727	$Y_3 = 0,007x_1 - 0,036x_2 + 0,624x_3 + 0,555x_4 - 70,4$	23
B C E L	0,787	$Y_3 = -0,022x_1 + 1,321x_2 + 0,363x_3 + 0,159x_4 - 64,3$	20
A B C E L	0,787	$Y_3 = -0,005x_1 - 0,014x_2 + 1,397x_3 + 0,360x_4 + 1,165x_5 - 63,7$	20

A – Weight of rabbit before slaughter /g/
B – Weight of carcass /g/
C – Length of carcass /cm/
D – Weight of front part /g/
E – Weight of loin /g/
F – Weight of hind part /g/
G – Weight of meat in loin /g/
H – Weight of meat in hind part /g/
J – Weight of bone in loin /g/
K – Weight of bone in hind part /g/
L – Weight of fat in loin /g/

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Summary

Using Regression Equations to Determine the Meat, Bone and Fat Content of White New Zealand Rabbit Carcasses.

The studies were conducted on 404 rabbits of White New Zealand breed. The data obtained served for calculation of correlation coefficients between meat, bone and fat content in the carcass and the parameters under study. These coefficients were used for calculating simple and multiple regression equations. The analysis of results obtained allowed to choose the most accurate equations suitable to evaluate meat and bone content in the carcasses of rabbits of White New Zealand breed, slaughtered at 2000 –-2600 g body weight.

The following equations were formulated to evaluate meat content in the carcass:

$$Y_1 = 0.240x_1 + 3.635x_2 - 0.255x_3 + 1.895x_4 - 69.8$$

/R = 0.973; Sy = 28 g/

where: x_1 - hot carcass weight /g/,

x_2 - length of carcass /cm/,

x_3 - weight of hind part /g/,

x_4 - weight of meat in hind part /g/,

and bone content in the carcass:

$$Y_2 = 0.001x_1 + 1.411x_2 + 0.016x_3 + 1.898x_4 - 30.5$$

/R = 0.877; Sy = 9 g/

where: x_1, x_2, x_3 - as above,

x_4 - weight of bones in hind part /g/.

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Resume

Equations de régression pour l'estimation de la composition en viande, en os, et en graisse des carcasses de lapereaux de race blanche Néo-Zélandaise.

Dans un essai sur 404 lapereaux de race blanche Néo-Zélandaise nous avons calculé les corrélations entre la composition de la carcasse en tissu musculaire, en os, et en graisse et les autores caractères étuidiés. On a mis au point des équations de régressions qui permettend d'estimer le pourcentage de viande et des os dans les carcasses de lapereaux abattus à 2000 - 2600 g de poids vif.

Pour le content en viande on propose:

$$Y_1 = 0.240x_1 + 3.635x_2 - 0.255x_3 + 1.895x_4 - 69.8$$

/R = 0.973; S_y = 28 g/

où x_1 - poids de la carcasse chaude /g/,

x_2 - longuer de la carcasse /cm/,

x_3 - poids de la partie postérieure de la carcasse /g/,

x_4 - poids de la viande dans la partie postérieure /g/.

Pour l'estimation du pourcentage des os:

$$Y_2 = 0.001x_1 + 1.411x_2 + 0.016x_3 + 1.898x_4 - 30.5$$

/R = 0.877; S_y = 9 g/

où x_1, x_2, x_3 - comme précedent, et

x_4 - poids des os dans la partie postérieure /g/.