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Possibilities of developing Favourable Body Fat Partition Via Selection Indexes – Application on Rabbits

Summary

Estimates of phenotypic and genetic parameters of body fat partition and other related traits were calculated using an experimental material of 152 New Zealand White rabbits of 15 bucks and 42 adult does. To construct nine selection indexes aiming at improving fat partition, estimates of phenotypic and genetic parameters for weight and linear dimensions of the live body were also obtained. The aggregate genotype included the percentage total body fat depositing subcutaneously and intermuscularly at the marketing age of 12 weeks. The full index included the weaning body weight, marketing body weight, body length, loin width and heart girth.
The full index had the highest correlation with the true breeding value (r_{TI} = 0.597). Comparable accuracy (r_{TI} = 0.561) would be expected from the best-reduced index (I_7 = 0.009 BW – 0.988 HG) combining marketing body weight and heart girth. At each round of selection with intensity =1, such a reduced index is expected to result in developing rabbits with advantageous fat partition in terms of higher percentage total body fat depositing subcutaneously (+0.35 unit %), intermuscularly (+1.91 unit %) and intramuscularly (as reflected by 0.15 unit % increase in carcass muscle yield.
As compared with its unrestricted form, the best reduced index reduced to zero change in total body fat ($I_{7(TBF)}$) would result in drastic decline in percentage total fat depositing as kidney knob and channel fat (+0.32 vs. –0.18 unit %) with little amelioration in percentage total fat accumulating in the other depots. Selection on $I_{7(TBF)}$ instead of I_7 would reduce improvement in marketing body weight (+0.52 vs. +0.33 gm), carcass yield (+0.10 vs. 0.04 unit %) and carcass boneless meat yield (+0.19 vs. 0.07 unit %) with increase of gain in carcass muscle yield (+0.15 vs. 0.32 unit %).

Key Words: Body fat partition, genetic parameters, selection indexes, New Zealand White rabbits

Zusammenfassung

Titel der Arbeit: **Beeinflussung der Körperfettverteilung mittels Selektionsindizes bei Kaninchen der Rasse Weiße Neuseeländer**

Phänotypische und genetische Parameter wurden an 152 Tieren der Rasse Weiße Neuseeländer, die im Alter von 12 Wochen geschlachtet wurden, geschätzt. Einbezogen waren verschiedene Körperfett- und weitere Schlachtmerkmale, die für die Konstruktion von Selektionsindizes bei unterschiedlicher Merkmalswichtung, genutzt wurden. Besonderes Augenmerk galt der Reduzierung von Gesamtfettgehalt sowie des subcutanen und intramuskulären Fettanteils. Die Selektionswirkungen der einzelnen Indexvarianten mit oder ohne Restriktion werden dargestellt und diskutiert Es konnte nachgewiesen werden, daß durch die Wahl bestimmter Indexvarianten eine selektive Beeinflussung der Schlachtkörper in Richtung höherer Marktqualität erreicht werden kann.

Schlüsselwörter: Körperfettverteilung, genetische Parameter, Selektionsindizes, Kaninchen, Weiße Neuseeländer

Introduction

Body fat partition influences the weight and acceptability of the carcass in that a gram of total body fat deposited as carcass fat (subcutaneously, intermuscularly or intramuscularly) is normally of much greater value than the same amount of total body fat accumulated as non-carcass fat (heart, caul, mesenteric or kidney knob and channel) depots.

Types of body fat partition have been identified for dairy cattle (e.g. TRUSCOTT et al., 1976; BUTLER-HOGG and WOOD, 1982), beef cattle (e.g. SHAHIN and BERG, 1985), beef x dairy crossbreds (e.g. KEMPSTER et al., 1976), water buffaloes (e.g. ABDALLAH et al., 1982), sheep (e.g. KEMPSTER, 1981; JONES, 1982); pigs (e.g. JONES et al., 1980) and broilers (e.g. GRIFFITHS et al., 1978; MERKLEY et al., 1980; SHAHIN et al., 1990). However, there is no available information on the genetics of fat partitioning so as to modify it to the profit of meat producers.

The aim of the present study was to investigate the possibilities of developing favourable body fat partition via selection indexes using dissection data on rabbits. With use of such a relatively lean species, it would be possible to develop selection indexes (S.I.) for animals with sub-optimal levels of fatness (unrestricted S.I.) as well as for those attaining optimal fatness (restricted S.I.).

Material and Methods

Source of Data. Over two successive parities during the spring of 1997, forty-two adult New Zealand White does were inseminated with fresh semen collected from fifteen bucks of the same breed at the experimental rabbitry of the Faculty of Agriculture, Ain Shams University, Egypt. From these matings one hundred and fifty two weaned male progeny were used in the present analyses.

Rearing of Animals. Following their birth, the experimental rabbits remained with their dams in breeding batteries till weaning at four weeks of age. They were then ear tagged and transferred to fattening batteries where fed ad libitum commercial pelleted diet (SHEMEIS and ABDALLAH, 1998) containing 16.3 % crude protein, 14.0 % crude fiber, 2.5 % crude fat and providing 2670 K. cal. digestible energy/kg. diet through to marketing at twelve weeks of age.

At marketing age, the animals were weighed and their body length, loin width and heart girth were measured (LUKEFAHR and OZIMBA, 1991). They were slaughtered and dressed with the heart, mesenteric, caul and kidney knob and channel fats being removed and weighed. The carcasses were weighed and held at 2 °C for 24 hours before subcutaneous fat (SCF), intermuscular fat (IMF) and muscles of the right sides were dissected. The weights of SCF and IMF were multiplied by two and added (1) to weights of the non-carcass fat depots to give total body fat and (2) to twice the dissected side muscle weight to give the carcass boneless meat weight.

Statistical Model of Analysis. The genetic and phenotypic parameters of the traits describing body weights and dimensions, total body fat partition and carcass attributes were estimated using the Least Squares and Maximum Likelihood program of HARVEY (1990) according to the following mixed model:

$$\mathbf{Y_{ijkl} = u + S_i + D_{ij} + P_k + e_{ijkl}}$$

where:

Y_{ijkl} = The observation of the l^{th} rabbit of the k^{th} parity from the j^{th} dam and the i^{th} buck;

u = The overall mean;

S_i = The random effect of the i^{th} buck (i= 1, 2,...,15);
D_{ij} = The random effect of the j^{th} dam (j= 1, 2,...,42) nested within the i^{th} buck;
P_k = The fixed effect of the k^{th} parity (k=1, 2); and
e_{ijkl} = The random error assumed N.I.D. $(0, \sigma^2_e)$.

The net income in the present study was defined as the revenue realised by the meat producer in terms of the added value to the carcass weight through the proportionate increase in deposition of total body fat as subcutaneous and intermuscular fats.
The true breeding value (T) was then defined as:

$$T = a_1 \, g_{SCF} + a_2 \, g_{IMF}$$

where:
g_{SCF} = The additive genetic value for subcutaneous fat measured as percentage of total body fat;
g_{IMF} = The additive genetic value for intermuscular fat measured as percentage of total body fat; and
a_1 and a_2 = The relative economic weights for SCF and IMF as percentage of total body fat, respectively.

An economic value that equals to unity was assigned to both traits, since a unit % of total body fat depositing as either SCF or IMF would equally contribute to the net profit of meat producer.
Sources of information (weaning weight; marketing body weight, body length, loin width and heart girth) were used in different combinations to construct nine selection indexes (CUNNINGHAM et al., 1970) out of which two were developed by imposing restriction on total body fat weight.

Results and Discussion

Phenotypic variation. Coefficients of phenotypic variation for the variables studied are given in Table 1.
Much larger amount of phenotypic variation was observed for the percentage total body fat depositing viscerally (30.2 to 38.7 %) and subcutaneously (30.4 %) than for that occurring intermuscularly (13.8 %). In the works of KEMPSTER et al.(1976) and SHAHIN and BERG (1985) on beef cattle, the phenotypic variation for the proportionate total body fat accumulating around the kidneys was much higher than for that deposited between muscles.
Slaughter traits showed low and comparable amounts of phenotypic variation (4.3 % for carcass yield; 3.2 % for carcass muscle yield and 3.1 % for carcass boneless meat yield).
Phenotypic variation in body weight decline from weaning to marketing (difference of 9.8 %). At marketing, the variation in the weight of the body (11.8 %) was considerably much lower than in the weight of its total fat (50.3 %).
Heritabilities. Heritability estimates (h^2) based on paternal half sib variance components for the traits considered in the study are also given in Table 1. Generally, body fat partition and slaughter traits were less heritable than live body measurements.

Heritability had low estimates (0.131 to 0.150) for intermuscular fat, mesenteric fat and caul fat, medium estimates for subcutaneous fat (0.266) and heart fat (0.329) and a high estimate (0.787) for kidney knob and channel fat.

Table 1
Mean ($\bar{x}$), Phenotypic Coefficient of Variation (C.V. %) and Heritability Coefficient (h^2) (± Standard Error) for Total Body Fat Partition, Related Slaughter Traits and Live Body Measurements (Mittelwerte, Variationskoeffizienten und Heritabilitätswerte untersuchter Körper- und Schlachtmerkmale)

Parameter / Trait	$\bar{x}$	C.V. %	$h^2 \pm SE$
i. Body fat partition traits[1]			
Percentage total body fat depositing as:			
Heart fat	8.33	36.62	0.329±0.200
Mesentric fat	16.69	30.16	0.150±0.094
Caul fat	5.36	30.58	0.139±0.046
Kidney knob and channel fat	17.17	38.72	0.787±0.198
Carcass subcutaneous fat	20.00	30.40	0.266±0.188
Carcass intermuscular fat	32.45	13.78	0.131±0.015
ii. Related slaughter traits			
Total body fat, gm	69.70	49.61	0.803±0.193
Carcass yield [2], %	48.80	4.28	0.193±0.125
Carcass boneless meat yield [3], %	85.09	3.08	0.329±0.191
Carcass muscle yield [4], %	80.24	9.47	0.219±0.151
iii. Live body measurements			
Weaning body weight, gm	425	21.65	0.631±0.187
Marketing body weight, gm	1895	11.82	0.820±0.225
Marketing body length, cm	31.0	5.00	0.145±0.111
Marketing loin width, cm	6.0	15.00	0.593±0.226
Marketing heart girth, cm	23.4	7.69	0.773±0.202

(1) Fat depot weight relative to total body fat weight.
(2) Hot carcass weight relative to marketing body weight.
(3) Twice side boneless meat weight relative to twice side weight.
(4) Twice side muscle weight relative to twice side weight.

The low heritability estimates for carcass yield (0.193, Table 1; 0.22, MAHAJAN and LAHIRI, 1983) and carcass muscle yield (0.219, Table 1; 0.16 and 0.19, GEBRIEL et al., 1989) justify the need for indirect selection for improving these traits.
The h^2-value of 0.82 for marketing body weight of New Zealand White rabbits estimated in the present study is higher than those previously obtained on the same breed (0.54, CARREGAL et al.,1980; 0.22, NIEDZWIADEK, 1978; 0.29, MAHAJAN and LAHIRI, 1983; 0.29, KROGMEIER et al., 1994). The h^2 estimates for weaning

Legends to Tables 2 and 3 (see page 197)

Table 2
Genetic (Above Diagonal) and Phenotypic (Below Diagonal) Correlations Among Total Body Fat Partition Traits, and Related Slaughter Traits and Live Body Measurements (Genetische (oberhalb Diagonale) und phänotypische Korrelationen zwischen Fettgehalts- und anderen untersuchten Merkmalen)

Table 3
Weighing Factors, Standard Deviation, Accuracy of Selection and Relative Efficiency Estimated for Each Index Without and with Restriction on Total Body Fat Weight (TBF) (Wichtungsfaktoren, Standardabweichung, Genauigkeit und Effizienz verglichener Indexvarianten)

Table 2

	i. Total body fat partition						*ii. Related slaughter traits*				*iii. live body measurements*				
	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}	V_{12}	V_{13}	V_{14}	V_{15}
i. Total body fat partition traits [1]															
Percentage total body fat depositing as:															
V_1 Heart fat	....	0.52	0.72	-0.92	-0.35	0.24	-0.92	-0.90	-0.42	0.20	-0.05	-0.78	-0.69	-0.91	-0.83
V_2 Mesenteric fat	0.13	....	0.59	-0.91	0.08	0.38	-0.73	-0.46	-0.57	0.05	-0.65	-0.88	-0.69	-0.28	-0.82
V_3 Caul fat	-0.04	0.10	....	0.14	-0.12	0.40	0.19	0.71	0.60	0.07	-0.24	0.29	-0.18	0.15	0.19
V_4 Kidney knob and channel fat	-0.58	-0.20	0.16	....	-0.10	-0.30	0.79	0.33	0.77	-0.21	-0.13	0.89	-0.07	0.89	0.94
V_5 Subcutaneous fat	-0.21	0.08	-0.02	-0.12	....	0.35	-0.01	0.28	0.51	-0.03	0.26	0.05	0.82	0.02	-0.10
V_6 Intermuscular fat	0.21	0.05	-0.15	-0.45	-0.22	....	-0.75	0.34	-0.48	-0.06	-0.74	0.91	0.16	-0.91	-0.65
ii. Related slaughter traits															
V_7 Total body fat weight, gm	-0.61	-0.21	0.15	0.88	0.02	-0.34	....	0.84	0.65	-0.23	-0.06	0.97	0.68	0.95	0.98
V_8 Carcass yield[2], %	-0.39	-0.20	0.29	0.03	0.15	-0.20	0.33	....	-0.14	0.51	-0.78	0.61	0.62	0.21	0.55
V_9 Carcass boneless meat yield[3], %	-0.22	-0.30	0.30	-0.01	0.19	-0.25	0.37	0.26	....	0.33	0.29	0.78	0.93	0.85	0.72
V_{10} Carcass muscle yield[4], %	0.69	0.20	0.04	-0.52	-0.07	-0.71	-0.51	0.10	0.80	....	0.37	-0.33	0.79	-0.25	-0.43
iii. Live body measurements															
V_{11} Weaning weight	-0.01	-0.06	-0.03	-0.05	0.06	-0.12	-0.01	-0.16	0.21	0.26	....	0.02	-0.19	-0.02	0.02
V_{12} Marketing body weight	-0.46	-0.23	0.15	0.80	-0.01	-0.37	0.93	0.27	0.45	-0.08	0.11	....	0.66	0.52	0.79
V_{13} Marketing body length	-0.07	-0.02	0.08	0.34	0.01	-0.20	0.32	0.10	0.29	0.14	0.03	0.38	....	0.69	0.55
V_{14} Marketing loin width	-0.46	-0.24	0.11	0.69	-0.01	-0.28	0.80	0.40	0.41	-0.05	0.05	0.36	0.34	....	0.92
V_{15} Marketing heart girth	-0.49	-0.19	0.15	0.81	-0.02	-0.34	0.91	0.23	0.41	-0.13	0.01	0.29	0.34	0.80	....

(1), (2), (3) and (4) as defined in footnote of Table 1.

Table 3

	Estimates obtained in constructing indexes							
	Weighing factors for:							
Index	Weaning weight	Marketing body weight	Marketing body length	Marketing loin width	Marketing heart girth	Standard deviation	Accuracy of selection	Relative efficiency
Without restriction on total body fat weight								
I_1 (full index)	-0.005	0.010	-0.138	-1.186	-0.513	5.762	0.597	100
I_2	-0.005	0.006	.....	.....	.....	2.395	0.395	66
I_3	.....	0.007	.....	.....	.....	2.186	0.368	62
I_4	.....	.....	0.301	-0.488	-0.556	1.662	0.321	54
I_5	.....	.....	.....	-1.200	.....	1.186	0.271	45
I_6	.....	.....	.....	.....	-0.667	1.440	0.298	50
I_7	.....	0.009	.....	.....	-0.988	5.083	0.561	94
With restriction on total body fat weight								
$I_{1\,(TBF)}$	-0.004	0.009	-0.083	-1.148	-0.651	5.646	0.591	99
$I_{7\,(TBF)}$	.....	0.008	.....	.....	-1.058	5.041	0.558	93

weight of 0.63, 0.55 and 0.51 obtained in the present study and in the works of OUHAYOUN et al.(1973) and MERKUSHIN (1979), respectively, are well above the estimates of 0.10 and 0.20 obtained by EL-AMIN (1974) and CHEVALET (1976), respectively.

As for body dimensions, the heart girth was the most heritable trait (0.773) followed by loin width (0.593) then body length (0.145).

Correlations. The genetic and phenotypic correlations among the traits considered in the study are given in Table 2.

Selection against excessively fat bodies would greatly decrease the percentage total body fat depositing as kidney knob and channel fat (r_G = +0.79). This would be associated with increase in the percentage total body fat accumulating around the heart (r_G = -0.92) and intestines (r_G = -0.37) and subcutaneously (r_G = -0.75). The genetic correlation between total body fat weight and its percentage occurring intermuscularly is negligible (-0.01), which indicates that in this material body fat weight in no way describes the genetic variation in its proportion depositing between muscles.

Genetic improvement of the percentage total body fat depositing as kidney knob and channel fat would seem to go along with improvement in carcass boneless meat yield (r_G = +0.77) and carcass yield (r_G = +0.33). Genetic correlations showed concomitant reduction in shares in total body fat would be expected at more drastic levels viscerally (around the heart, 0.91; and intestines, 0.92) than in the carcass (intermuscularly, -0.10; and subcutaneously, -0.30)

Marketing body weight and dimensions are genetically correlated positively with total body fat weight (r_G = 0.68 to 0.98) and its proportion depositing as kidney knob and channel fat (r_G = 0.82 to 0.94), and genetically correlated negatively with percentage total body fat accumulating around the heart (r_G = -0.69 to -0.91) and intestines (r_G = -0.18 to -0.82). This relation expresses early maturity of large sized male rabbits of this breed.

In spite of the foregoing relationships, marketing body length and loin width are less useful than marketing body weight and its traditional estimator, the heart girth, to evaluate genetic differences in total body fat partition due to their lower h^2 values.

Indexes. The estimates of genetic and phenotypic (co)variances and the relative economic values obtained in the present study were used to construct nine selection indexes .

Table 3 gives the weighing factors, standard deviation, accuracy of selection for each index together with the relative efficiency in relation to the full index.

Weighing factors were positive for marketing body weight and negative for marketing body dimensions due to their respectively high positive and negative genetic correlations with intermuscular fat.

The maximum accuracy of selection (r_{TI} = 0.597) was obtained using the full index (I_1). Whereas selection based on body weights (I_2 and I_3) or body dimensions (I_4, I_5 and I_6) is expected to be of little effect in predicting the true breeding value considered in the present study (r_{TI} = 0.368 to 0.395 and 0.271 to 0.321, respectively), selection on the best reduced index involving marketing body weight and heart girth (I_7) is expected to be 96 % as efficient as the full index. Restricting the expected genetic change in total body fat weight to zero through use of $I_{1(TBF)}$ and $I_{7(TBF)}$ would cause

only one percent reduction in the accuracy of selection.
Table 4 gives results of the expected outcome for individual traits through use of the full index and the best reduced index in their original (I_1 and I_7) and restricted forms ($I_{1(TBF)}$ and $I_{7(TBF)}$) using intensity of selection = 1.0.

Table 4
The genetic changes per generation in total body fat partition characteristics, related slaughter traits and live body measurements expected from selection with intensity = 1.00 using indexes with and without restriction on total body fat (TBF) (Selektionsfortschritt je Generation (SI= 1.0) bei Körperfettmerkmalen und weiteren Körper- und Schlachtmerkmalen bei Selektionsindizes mit und ohne Restriktion)

	Indexes*				
	Without restriction on total body fat weight		With restriction on total body fat weight		
	I_1 full index	I_7 best reduced index	$I_{1(TBF)}$ full index	$I_{7(TBF)}$ best reduced index	Actual mean
i. Total body fat partition traits					
Percentage total body fat depositing as:					
Heart fat	-0.08	-0.09	+0.15	+0.05	8.33
Mesenteric fat	-0.53	-0.27	-0.26	-0.10	16.69
Caul fat	+0.11	+0.06	+0.08	+0.05	5.36
Kidney knob and channel fat	+0.78	+0.37	-0.10	-0.18	17.17
Subcutaneous fat	+0.08	+0.35	+0.11	+0.36	20.00
Intermuscular fat	+2.32	+1.91	+2.27	+1.90	32.45
ii. Related slaughter traits					
Total body fat, gm	+4.9	+3.0	0.00	0.00	69.7
Carcass yield, %	+0.33	+0.10	+0.24	+0.04	48.80
Carcass boneless meat yield, %	+0.08	+0.19	-0.09	+0.07	85.09
Carcass muscle yield, %	-0.60	+0.15	-0.24	+0.32	81.45
iii. Live body measurement					
Marketing body weight, gm	+78	+52	+48	+33	1895

* Full index combines: Weaning body weight, together with marketing body weight, body length, loin width and Heart girth
Best index combines: Marketing body weight and heart girth.

Selection based on the full index is expected to develop rabbits having higher body fat weight (+4.9 gm) and favourable body fat partition (+2.40 unit % increase in percentage total body fat depositing as carcass fat). This genetic gain in the total merit is expected to be associated with increases of 78 gm in marketing body weight, 0.33 unit % in carcass yield, 0.08 unit % in carcass boneless meat yield and a reduction of 0.60 unit % in carcass muscle yield. It is, however, possible through use of the restricted full index ($I_{1(TBF)}$) to obtain comparable improvement in body fat partition with lower reduction in carcass muscle yield (-0.24 unit %) at the cost of genetic change in carcass boneless meat yield from gain (+0.08 unit %) to loss (-0.09 unit %) and reduction in genetic improvement of 30 gm in marketing body weight and 0.07 unit % in carcass yield.
Selection on the best reduced index (I_7) is expected to develop rabbits with advantageous fat partition in terms of higher percentage total body fat depositing subcutaneously (+0.35 unit %), intermuscularly (+1.91 unit %) and intramuscularly (as

reflected by +0.15 unit % increase in carcass muscle yield). As compared with its unrestricted form, the best reduced index without changing total body fatness ($I_{7(TBF)}$) would result in drastic decline in percentage total body fat depositing as kidney knob and channel fat (+0.37 vs. -0.18 unit %) with slight amelioration in that accumulating in the other depots. Selection on $I_{7(TBF)}$ instead of I_7 would reduce improvement in marketing body weight (+52 vs. 33 gm), carcass yield (0.10 vs. 0.04 unit %), carcass boneless meat yield (+0.19 vs. 0.07 unit %) and would increase gain in carcass muscle yield (+0.15 vs. 0.32 unit %).

It could be concluded that in case of sub-optimal level of body fatness the use of body weight (BW) and heart girth (HG) taken at marketing as sources of information in the selection index

$$\mathbf{I_7 = 0.009\ BW - 0.988\ HG;\ (r_{TI} = 0.561)}$$

would be recommended to optimize selection for the given aggregate genotype, and its restricted form:

$$\mathbf{I_{7(TBF)} = 0.009\ BW - 1.058\ HG;\ (r_{TI} = 0.558)}$$

would be advised in case of populations reaching optimal body fatness.

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TAGUNGSANKÜNDIGUNGEN

35. Kulmbacher Woche

08. bis 10. Mai 2000
Stadthalle Kulmbach

Veranstalter: Bundesanstalt für Fleischforschung

In der Zeit vom 08. bis 10. Mai 2000 (Beginn 10.00 Uhr, Stadthalle Kulmbach) findet die nunmehr „**35. Kulmbacher Woche**" statt. Das aktuelle Programm sieht Vorträge und Poster u.a. zu gesunder Ernährung, den Anforderungen an die Fleischwirtschaft im neuen Jahrtausend, qualitätsorientierter und -gerechter Rinder- und Schweineproduktion, Markenfleischprogrammen, Tierschutz und Schlachtung, speziellen Fragen der Fleischverarbeitung und zu Inhaltsstoffen von Fleischerzeugnissen vor. Neben einem Lebensmittelrechtlichen Kolloquium wird auch über spezielle Fragen der Fleischanalytik berichtet.

Die Anmeldung erfolgt bis zum 14.04.2000 an: Bundesanstalt für Fleischforschung
E.-C.-Baumann-Straße 20
95326 Kulmbach

Tel: 09221/803 269 Fax: 09221/803 244 e-mail: baff@compuserve.com

3. Wilhelm-Stahl-Symposium am 16. und 17. Mai 2000 in Rostock

Veranstalter:

- **Institut für Tierproduktion Dummerstorf der Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern**
- **Forschungsinstitut für die Biologie landwirtschaftlicher Nutztiere Dummerstorf**
- **Agrar- und Umweltwissenschaftliche Fakultät der Universität Rostock**
- **Landwirtschaftlich-Gärtnerische Fakultät der Humboldt-Universität zu Berlin**

Unter der Thematik: „**Effiziente tierische Leistung in Verbindung mit einer nachhaltigen Produktion**" findet am 16. und 17. Mai 2000 im Hörsaal der Agrar- und Umweltwissenschaftlichen Fakultät der Universität Rostock, Justus-von-Liebig-Weg, Rostock, das nunmehr 3. Wilhelm-Stahl-Symposium statt.

Tagungsschwerpunkte sind:

- Agrarpolitische, ökonomische, ökologische und verbraucherorientierte Aspekte
- Züchtung, Fütterung und Haltung der Hochleistungskuh
- Zukunftsfähige Schweineproduktion
- Fleischproduktion mit Rind, Schaf und Geflügel

Organisationsbüro: Institut für Tierproduktion Dummerstorf der
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