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Additive genetic variance and covariance in some reproductive disorders in Hungarian Holstein Friesian using multi-trait animal model

Summary

Relationships between some reproductive disorders in the first 3 lactations of Holstein Friesian cows were investigated for 1886 lactation records. Multiple-trait maximum likelihood procedure which included sire, cow within sire as random effect and herd, parity, month and year of calving as fixed effects was used to estimate heritabilities and repeatabilities for the studied traits. Abortion within 60 days, retained placenta, ovarian cysts, calving difficulty, dystocia, mastitis, and calving type were coded as 0 and 1 for heritability and repeatability estimations. Pooled and separate analysis were applied on the first 3 lactations. Abortion within 60 days, retained placenta, ovarian cysts, calving difficulty, dystocia, mastitis, abortion no. and calving type had moderate heritability estimates which ranged from 0.15 to 0.24. Low heritability estimates and a weak sire variance component were obtained for milk fever. The most frequent disorder traits were mastitis, milk fever, abortion no. calving type and calving difficulty (0.37 to 0.72). Up word trend of heritability estimates with advancing order of lactation was observed for mastitis, abortion within 60 days, and abortion no. while heritability estimates for calving type, calving difficulty and dystocia had a back word trend. These results help in determining the suitable age of selection. Additive genetic variances and covariances among the studied traits have indicated reducing incidence rates if selection index procedure used in this filed. Strong negative genetic correlation between milk fever and abortion no.(-0.429) while negative phenotypic correlations between all studied traits were not more than -0.120 which was estimated for calving difficulty and abortion no.

Key Words: dairy cattle, heritability, repeatability, correlation, reproductive disorders, Hungarian Holstein Friesian

Zusammenfassung

Titel der Arbeit: **Genetische Parameter von Reproduktionsmerkmalen untersucht an Ungarischen Holstein Friesian Rindern**

Es wurden die Beziehungen zwischen einigen Reproduktionsmerkmalen mit 1886 Laktationen von 630 Kühen und 57 Bullen der Rasse Ungarische Holstein Friesian untersucht. Zur Schätzung der genetischen Parameter wurden mittels der Maximum-Likelihood-Procedure die Varianzkomponenten Vater und Mutter innerhalb Väter und Herde sowie als fixe Effekte Trächtigkeit, Kalbemonat und -jahr berücksichtigt. Einbezogen wurden die Merkmale Verkalbung innerhalb 60 Tagen, Nachgeburtsverhaltung, Eierstockzyste, Kalbeschwierigkeit, Schwergeburt, Milchfieber, Mastitis, Anzahl Verkalbungen und Kalbetyp. Die Schätzungen erfolgten getrennt nach den ersten drei Laktationen und am Gesamtmaterial. Die Mehrzahl der Merkmale erreichten einen h^2 Schätzwert zwischen 0,15 ± ,08 und 0,24 ± ,08. Der niedrigste Wert lag beim Merkmal Milchfieber mit nur 0,03 ± ,03 bei geringer Vätervarianz. Die besten Wiederholbarkeitskoeffizienten ergaben sich für Mastitis, Milchfieber, Kalbenummer, Kalbetyp und Schwergeburt (0,37 bis 0,72). Höhere h^2-Schätzwerte mit steigender Laktationsnummer wurden für Mastitis, Verkalbung innerhalb 60 Tagen, und Verkalbenummer gefunden während für Kalbetyp, Schwergeburt und Dystocia diese Werte mit steigender Laktationsnummer geringer wurden. Diese Ergebnisse sind bei altersabhängiger Selektionsentscheidung zu beachten. Die genetischen und phänotypischen Beziehungen zwischen den einbezogenen Merkmalen werden dargestellt und diskutiert.

Schlüsselwörter: Milchrind, Heritabilität, Korrelationen, Reproduktionsmerkmale, Ungarische Holstein Friesian

Introduction

Reproductive performance of Holstein Friesian cattle under Hungarian conditions are below the acceptable level compared with other herds of this breed in original situation (GÁSPÁRDY et al., 1995). Low reproductive performance (such as conception and pregnancy rates) affects the profitability of dairy herds by decreasing milk produced per cow per day, the calf crop, and the magnitude of culling rate (BRITT, 1985). Minimization of the reproductive disorders occurrence such as retained placenta, metritis and ovarian cysts which cause from 2 to 5 weeks delay in calving interval was the one way to improve the reproductive efficiency (ERB et al., 1980). Disorders and milk production are interrelated in the dairy cow: the stress of milk production predisposes some disorders and may interfere with fertility; diseases can also interfere with concurrent yield; reproductive diseases have negative effects on breeding performance along in addition with pregnancy affects persistency of lactation (ERB et al., 1985). Moderate heritability (0.38) for retained placenta was reported by ERB et al. (1958). Heritability of dystocia was 0.17 in the first parity and decreased thereafter to .08 and .05 for second and third parity or greater parity cows was reported by POLLAK and FREEMAN (1976). On the other hand, pooled data set of different parities generated the lowest heritability estimate of 0.01 for dystocia as showed by MARTINEZ et al. (1983). Calving difficulty occurs more than 50% of all calves during calving time (PHILIPSSON, 1976a). PHILIPSSON (1976b) found that 45.5 and 49.7% of calf mortality were due to calf difficulty of heifers and cows respectively during parturition. Also he found that the genetic correlation between direct effects for stillbirth rate and calving difficulty was 0.6 and the genetic correlation between maternal effects for stillbirths rate and dystocia was 0.64.
The objective of this study was to examine the genetic and phenotypic variability through different interrelationships which may exist in some dairy cattle disorders at different parities. It is aimed to explain the relationship between reproductive disorders as an advanced step for selection against the high costly reproductive disorders which in turn may improve the performance of dairy cattle.

Materials and Methods

Animal conditions and structure of the data

Three herds from the Hungarian Holstein Friesian population were evaluated in this study. Data are from the first 3 lactations lasted from August 1983 until October 1993. Lactations could be completed at any stage by death, sale or drying-off. Complete lactation of 1886 records of 630 Hungarian Holstein Friesian cows were used in the analyses. All data which are concerned to hygiene were collected every month during the farm milk test day by a research technician. Emphasis was placed on accurate recording of calving, hygienic condition, breeding, culling, and management practices. All cows calved under observation for two days before and for 305 days after calving. The reproductive disorders included in this study were mastitis, milk fever, abortion within 60 days of pregnancy, abortion no., calving type, calving difficulty, dystocia, retained placenta and ovarian cysts. Positive observation responses were coded as 1 while negative results for studied problem in hygiene obtained the code 0 except the trait of abortion no. A cow which was diagnosed and treated by a veterinarian during the farm visits as a clinical difficulty of productive disorder was considered as an incident of mastitis and milk fever. Incidence abortion within 60 days and abortion no. by examination of each concepted cow after 60 days from last insemination was recorded. Calving difficulty were assigned to be trouble some or ease let down of the calf during parturition. Normal delivery or caesarean (surgical delivery) was the base of recording calving type. Diagnosis of cystic ovary was based on rectal palpation of ovarian structures by the veterinary practitioner to determine the situation of ovaries. Each cow had assistance during parturition was recorded as a positive dystocia. After parturition of 24 hours each cow had not expelled all embryo members was recorded as a positive retained placenta.

Statistical model

The relationship coefficient matrix included 1886 lactation records of 630 cows, 57 sires and the half-sib sister groups involved 8-14 cows per sire. Paternal half-sib sister covariances were determined by animal mixed model {AMM} analysis of variance. The general mathematical model for these data was

$$y_{ijk_l} = \mu + S_i + C_{ij} + H_k + e_{ijkl} \qquad (1)$$

where

y_{ijkl}: is the measurement of the trait on the cow (transformed during analysis of variance),

μ: is the population mean,

S_i : is a random effect of the ith sire,

C_{ij} : is a random effect of the jth cow nested within the ith sire,

H_k : is a herd effect (parity, month and year of calving), and

e_{ijkl}: is a random residual associated with each measurement.

The linear animal mixed model in matrix notation is given by

$$y = Xb + Z_1 a + Z_2 c + e \qquad (2)$$

where

y is the vector of observations, X is the known matrix, b is the vector of fixed effects (parity, month and year of calving), Z_1, Z_2 are the known incidence matrices, a, c are non-observable sire and cow random vectors.

Expectation and variances are defined as:

$$E\begin{bmatrix} a \\ c \\ e \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \qquad \mathrm{var}\begin{bmatrix} a \\ c \\ e \end{bmatrix} = \begin{bmatrix} A\sigma^2{}_a & \sigma_{au}\ldots\ldots\ldots\ldots.0.0 \\ \sigma_{au} & B\sigma^2{}_c\ldots\ldots.I\sigma^2{}_{e_1} \\ 0 & I\sigma^2{}_{e_1}\ldots\ldots I\sigma^2{}_{e_2} \end{bmatrix}$$

where

A and B are the numerator relationship matrix among animals of sire and cow within sire, I is the identity matrix, $\sigma^2{}_a$ and $\sigma^2{}_c$ are the direct random additive genetic effect of the sire and cow. $\sigma^2{}_{e_1}$ and $\sigma^2{}_{e_2}$ are the sire and cow population error variance.

The animal mixed model equation (AMME) are

$$\begin{bmatrix} X'R^{-1}X \ldots\ldots X'R^{-1}Z_1 \ldots\ldots\ldots\ldots X'R^{-1}Z_2 \\ Z'_1 R^{-1}X \ldots\ldots Z'1R^{-1}Z1+G^{-1} \ldots\ldots Z'1R^{-1}Z2 \\ Z_{'2}R^{-1}X \ldots\ldots Z'_2 R^{-1}Z_1 \ldots\ldots\ldots\ldots Z'_2 R^{-1}Z_2 + k^{-1}A^{-1} \end{bmatrix} \begin{bmatrix} B^{\wedge} \\ a^{\wedge} \\ c^{\wedge} \end{bmatrix} = \begin{bmatrix} X'R^{-1}y \\ Z'_1 R^{-1}y \\ Z'_2 R^{-1}y \end{bmatrix}$$

where n denote the number of animals and t the number of traits. Data are ordered traits within animals and missing observation are accounted for by zero columns in X and Z (MEYER, 1983).

Multi-Traits Derivative Free Restricted Maximum Likelihood (MTDFREML) procedure developed by BOLDMAN et al. (1995) are used to estimate all genetic and phenotypic covariances and predicting the breeding value for all studied traits.

The variance structure from the sire model, in general terms is :

$$\sigma^2{}_p = \sigma^2{}_s + \sigma^2 c + \sigma^2{}_e \qquad (3)$$

where $\sigma^2{}_p$ is the total phenotypic variance, $\sigma^2{}_s$ is the sire component of variance between paternal half sib groups which involve quarter of the additive variance. The cow model was used in separate analysis of variances and structure of the variance component was :

$$\sigma^2 p = \sigma^2 c + \sigma^2 e \qquad (4.1)$$

$$\sigma^2 c = \sigma^2 a_d + \sigma^2 E_p \qquad (4.2)$$

Where $\sigma^2{}_p$ is the total phenotypic variance, $\sigma^2{}_c$ is the cow component of variance, $\sigma^2{}_a$ is the additive genetic variance, $\sigma^2 E_p$ is the permanent environmental variance, $\sigma^2{}_e$ and is the residual variance.

Estimation of heritability by using $(4\sigma^2{}_s / \sigma^2{}_p)$, repeatability by using $(\sigma^2 s + \sigma^2 c / \sigma^2 p)$, genetic correlation by using $(\sigma_{nn} / [\sigma^2{}_n . \sigma^2{}_n]^{0.5})$ and phenotypic correlation by using $(\sigma_{nn} / [\sigma^2{}_n . \sigma^2{}_n]^{0.5})$. Where $\sigma._{s_1 s_2}$ and $\sigma._{p_1 p_2}$ are sire genetic and phenotypic covariance between trait 1 and trait 2 and are estimated from the analysis of measurements of the two diseases on the same animal (observed scale); $\sigma^2{}_{s_1}$, $\sigma^2{}_{s_2}$ and $\sigma^2{}_{p_1}$, $\sigma^2{}_{p_2}$ are the sire additive genetic and phenotypic variances for the same disorders.

Results and discussion

The incidence percentages for some reproductive disorders in Hungarian Holstein Friesian cows are presented in Table 1. The most frequent occurrence either in number or percentages of milk fever, calving type, calving difficulty and dystocia were observed in the 2nd lactation. Among all disorders the most frequent mastitis occurrence was observed in the 1^{st} lactation and followed by also high percentage in the 3^{rd} calving. This is may be due to increasing sensitivity of the superior lactating cows to this disease with advancing order of lactation. ERB et al. (1985) found that, heifers that were older at first calving were more likely than younger heifers to have mastitis. The incidence rate of abortion within 60 days was very high in the first lactation. This may be due to lowering and the unsuitable age at first conception and calving. Therefore, this disorder was from an economic point of view should be considered in the future for production of first calf heifers. Another reason may be also the insufficient maturity specially for the hind quarters of the primiparous including the reproductive system (HAMMOND et al., 1983).

Table 1
Observation number and percentage for some reproductive disorder in Hungarian Holstein Friesian cows (Tierzahl, Merkmale und deren Auftretenshäufigkeit)

	Parities			
	1st	2nd	3rd	Total
Record numbers	630	628	628	1886
Traits		Observation	Number	
Mastitis	67	53	89	209
Milk fever	41	81	61	183
Abortion within 60 days	112	70	58	240
Abortion no.	28	8	14	50
Calving type	16	32	16	64
Calving difficulty	30	56	46	132
Dystocia	20	51	34	105
Retained placenta	96	58	46	200
Ovarian cysts	92	58	46	196
More than one disorder	128	161	218	507
		Observation	Percentage	
Mastitis	10.63	8.44	14.17	11.08
Milk fever	6.51	12.90	9.71	9.70
Abortion within 60 days	17.78	11.15	9.24	12.73
Abortion no.	4.44	1.27	2.23	2.65
Calving type	2.54	5.10	2.55	3.39
Calving difficulty	4.76	8.92	7.32	7.00
Dystocia	3.17	8.12	5.41	5.57
Retained placenta	15.24	9.23	7.33	10.60
Ovarian cysts	14.61	9.23	7.33	10.39
More than one disorder	20.32	25.64	34.71	26.88

The amount of cow variance components for all studied traits were greater than corresponding for sire variance components as resulted from the pooled analysis (Table 2). This may be due to including of permanent environmental variance along with dominant variance in the cow variance component (FALCONER, 1988). The contribution of sire and cow component variance were varied between different traits. The highest estimate of sire variance component was observed for calving difficulty while the highest estimate of cow variance component was observed for milk fever as shown in Table 2. Therefore, constructing selection index for reducing incidence of calving difficulty and milk fever must be based on the estimates of sire and cow variance components.

Table 2

Estimates of sire $\sigma^2 s$, cow $\sigma^2 c$, residual $\sigma^2 e$ and phenotypic $\sigma^2 p$ estimates component of variance for some disorder traits in dairy cattle that generated from pooled analysis (Varianzkomponenten für Merkmale, ermittelt am Gesamtmaterial)

Traits	$\sigma^2 s$	$\sigma^2 c$	$\sigma^2 e$	$\sigma^2 p$
Mastitis	0.008	0.091	0.094	0.193
Milk fever	0.001	0.098	0.085	0.184
Abortion within 60 days	0.007	0.010	0.100	0.117
Abortion No.	0.004	0.071	0.023	0.098
Calving type	0.002	0.022	0.030	0.054
Calving difficulty	0.002	0.011	0.021	0.034
Dystocia	0.003	0.013	0.048	0.064
Retained placenta	0.006	0.010	0.084	0.100
Ovarian cysts	0.006	0.010	0.083	0.098

In general, the heritability estimates of these disorders (Table 3) in the studied population were relatively higher compared with other reports (LIN et al., 1989; POLLAK and FREEMAN, 1976; MARTINEZ et al., 1983). Therefore design and application of accurate selection programs along with more genetic evaluation of Hungarian Holstein Friesian population will play an important role in decreasing incidence rates of different problems in hygiene, improving the general level of dairy cattle performance and reducing involuntary culling. Large variability among heritability estimates for disorder traits is to be expected because of differences in the clinical definition of diseases, in the accuracy of data recording, and in sample sizes. Also, one of the biological feature is that the natural immunity of the lactating cows which greatly differs from one herd to another may have a great impact on the general management practices and hygiene.

Table 3

Estimates of repeatability and heritability for some reproductive disorder traits in Hungarian Holstein Friesian cows (Wiederholbarkeits- und Heritabilitäts-Schätzwerte)

Traits	Repeatability	Heritability			
	Pooled	Pooled	1st	2nd	3rd
Mastitis	0.47±.11	0.17±.05	0.09±.01	0.11±.01	0.19±.02
Milk fever	0.53±.07	0.03±.03	0.01±.00	0.05±.01	0.01±.00
Abortion within 60 days	0.09±.01	0.24±.08	0.12±.02	0.15±.04	0.28±.04
Abortion No.	0.72±.22	0.17±.07	0.08±.03	0.14±.07	0.21±.08
Calving type	0.41±.13	0.15±.08	0.18±.04	0.10±.03	0.09±.01
Calving difficulty	0.37±.09	0.21±.08	0.24±.09	0.12±.07	0.11±.04
Dystocia	0.20±.04	0.18±.07	0.20±.09	0.11±.01	0.07±.01
Retained placenta	0.10±.02	0.24±.08	0.14±.04	0.28±.08	0.05±.01
Ovarian cysts	0.10±.02	0.24±.08	0.07±.01	0.26±.09	0.13±.01

Heritability estimates of 0.24 for calving difficulty in the 1st lactation and 0.28 and 0.26 for retained placenta and ovarian cysts respectively in the 2nd parity are higher than the corresponding values which reported by BRINKS et al. (1973) and POLLAK and FREEMAN (1976). Trend for heritability estimates with advanced order of lactation was ascending for mastitis, abortion within 60 days, and abortion no. and descending for calving type, calving difficulty and distocyia. High estimates of repeatability of both mastitis and abortion incidence within 60 days were associated with increase and wide genetic variation with advancing order of lactation. This may be indicate that early selection against these traits within the first lactation will be very effective to improve the reproductive economic gain of the dairy herds. Curve linear trends of heritability estimates were observed for milk fever, retained placenta and ovarian cysts as shown in Table 3. These trends are in disagreement with the reported results of THOMPSON's (1984) except for retained placenta which was nearly in agreement. Estimates of heritability that generated from pooled analysis were in moderate level compared with those obtained from separate analysis of the 3 first lactation.

Correlation between subsequent lactation for the same disorder traits (repeatability) were presented in Table 3. The major repeated disorder traits were mastitis, milk fever, abortion no., calving type, and calving difficulty. Trait with the highest repeatability (0.72) was the abortion no. This can be due to the high magnitude the amount of the cow component of variance (Table 2). On the other hand the low magnitude of cow component of variance in abortion within 60 days is might be the reason of low repeatability compared with other estimates. This also may be due to low the contribution of permanent environmental effect because heritability estimates of abortion within 60 days were in general not low as shown in Table 3 of pooled and separate analysis of variance. Among the current studied disorders it appears that mastitis, milk fever, abortion no. and calving type are considered as high repeated observations that may play important role in voluntary direct and significant indirect culling of the high lactating cows from the most dairy cattle herds.

Table 4
Genetic[1] and phenotypic[2] correlations between some reproductive disorders in Hungarian Holstein Friesian cows as generated from pooled analysis (Genetische und phänotypische Korrelationen zwischen Merkmalen, ermittelt am Gesamtmaterial)

Traits		1	2	3	4	5	6	7	8	9
Mastitis	1	.	0.774	0.291	0.102	-0.012	-0.080	0.038	0.240	0.222
Milk fever	2	0.988		0.298	0.105	-0.043	-0.011	0.015	0.269	0.255
Abortion within 60 days	3	0.086	0.030		0.432	0.000	0.008	0.057	0.900	0.890
Abortion No.	4	-0.238	-0.429	0.629		-0.029	-0.120	-0.028	0.482	0.488
Calving type	5	0.368	0.277	0.017	-0.118		0.690	0.577	0.015	0.018
Calving difficulty	6	0.280	0.210	0.019	-0.190	0.350		0.230	0.110	0.180
Dystocia	7	0.329	0.395	-0.060	0.088	0.844	0.110		0.080	0.081
Retained placenta	8	-0.116	-0.183	0.895	0.738	-0.227	0.120	-0.181		0.988
Ovarian cysts	9	-0.124	-0.202	0.890	0.758	-0.217	0.090	-0.152	0.999	

1 : estimates below diagonal, 2: estimates above diagonal

All genetic and phenotypic correlations between disorder traits using sire variance and covariance components which generated from pooled analysis were presented in Table 4. Non additive covariance component between abortion within 60 days and calving type is very low, therefore the phenotypic correlation between these two traits was close to zero. The genetic correlations of milk fever with each of mastitis, abortion no., abortion within 60 days, retained placenta and ovarian cysts were positive and ranged from 0.63 to 0.99 (Table 4). On the other hand there are some genetic relationships are lease than or equal $\pm$ 0.10 which might be indicate to weakness the genetic association between these traits (Table 4). Retained placenta and ovarian cystic showed strong phenotypic correlation with abortion within 60 days. This indicates that most of the cows that had either retained placenta or ovarian cysts probably would aborted their foetus in early months of pregnancy. Other phenotypic relationships were moderate or low indicating weak association between these traits.

Conclusions

Increasing incidence rates of any reproductive disorders such as dystocia, retained placenta, cystic ovary … etc. play important role in indirect significant culling of the genetically superior milk production lactating cows. Reproductive disorder considered herein are defined broadly. In general genetic and phenotypic variances and covariances obtained indicate that improving these disorders through selection seems possible. The strong and positive genetic relationships between milk fever and mastitis, abortion within 60 days and abortion no., retained placenta and ovarian cystic, distocyia and calving type, retained placenta and ovarian cysts indicate that may be selection against any one of these dairy cattle disorders would result in a positive correlated effect with respect to the other traits. If selection index is desired procedure in future to reduced incidence rates of mastitis and milk fever, that need to make a restriction on increasing abortion no., because there are negative relationship between these traits. Retained placenta was very correlated genetically with abortion no. within 60 days and abortion no. This indicate that high possibility of aborting light or heavy pregnant cows which obtained in the previous lactation a positive retained placenta. Abortion no. had direct impact on general breeding performance of dairy cattle and yearly economic calf crop by high repeated aborted heavy pregnant cows. Cows with high repeated milk fever had moderate phenotypic correlation with abortion no. within 60 days, retained placenta and ovarian cysts compered with other disorders. On the other hand moderate negative genetic correlation were reported between milk fever and both of retained placenta and ovarian cysts resulting in an indicate that association of milk fever with poorer breeding performance and increase risk of being culled. Estimates of repeatability for mastitis and abortion no. within 60 days were very high and associated with the magnitude of genetic variance and covariance components from the first to the third calving. This may indicate that the importance of early selection against these traits within the first lactation which would be effective in improving the economic gain of the dairy farms.

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Die beinahe jährlich ergänzte Kulmbacher Reihe wird nun mit ihrem 17. Band fortgesetzt. Er ist das Ergebnis der Vorträge, die im Hause der Bundesanstalt für Fleischforschung zu den 25. Kulmbacher Fortbildungstagen gehalten wurden. Mit dem Thema dieser Tagung, die Fleisch in den Bezug zu Ökologie und Nachhaltigkeit setzte, gewinnt der Band große Tagesaktualität, strebt aber auch längerfristige Gültigkeit an.
Die Serie von insgesamt 9 ausführlich gehaltenen Artikeln beginnt mit der definitorischen Aufarbeitung des Begriffes Nachhaltigkeit aus der Sicht der Fleischerzeugung. Nachhaltige Fleischerzeugung - also die im Gesamtsystem denkende und um den Erhalt des Gesamtsystems bemühte Produktion - ist, so das wesentliche Kernkriterium, nur in der Flächenbindung denkbar. Genau in dieser wird das erste Problem der deutschen Fleischerzeuger festgestellt, die ja überwiegend Flächen unabhängig produzieren. Die folgenden beiden Kapitel zeigen Teilaspekte von Strategien, mit denen in der Schweine- und Rindermast versucht wird, in der Flächenbindung und nach ökologischen Prinzipien zu produzieren. Die Auswirkungen auf die Fleischqualität sind dabei gering, die in der weniger intensiven Produktion fehlende Menge führt eher zu Schwierigkeiten. Nachhaltige Produktionsmethoden haben, so wird in einem weiteren Beitrag vermerkt, sogar generell kaum Effekte auf die Fleischqualität. Dies gilt insbesondere auch für alle erwünschten und unerwünschten Inhaltsstoffe und Rückstände.
Ein bisher wenig in den Zusammenhang der Nachhaltigkeit gesetztes Thema sind die physiologischen Grenzen des Wachstums bei Schweinen und Geflügel. Auch Öko-Produktion muss auf Rentabilität bedacht sein, die Fleischausbeute ist somit auch für sie ein beachtlicher Faktor. Dennoch zeigt der Beitrag, dass die mit hoher Ausbeute gekoppelten Fleischqualitätsmängel und die dazu parallel laufenden Verluste an Tieren und Produkten nicht mit Nachhaltigkeit vereinbar sind. Noch weiter gedacht ist die Nutzung von Ressourcen in dem folgenden Beitrag zu den Schlachtnebenprodukten, die ja als nachwachsende Rohstoffe zu verstehen sind. Aufgrund ihres zusammen genommenen enormen Wertes fügen sich diese Rohstoffe nahtlos in den Kontext des Bandes ein. Den Abschluss der Artikelserie bilden drei Kapitel mit sehr praxisnahem Hintergrund. Direktvermarktung ist für viele Öko-Betriebe der Marktweg der Wahl. Die Atomisierung des Marktes führt aber, wie sich erweist, zur Unübersichtlichkeit in der Qualität der Fleischerzeugnisse, nicht selten sogar zur Beeinträchtigung. Abhilfe gegen solche Unzulänglichkeiten ist z. B. in Kooperationsstrukturen zu suchen, in denen Beratung ein zentrales Anliegen ist. Solche Strukturen werden in dem ergänzenden Bericht über die praktischen Erfahrungen eines Qualitätsfleischprogrammes systematisch dargestellt, in welchem die Isolation der Produzenten durch Kooperation in Beratung, Beschaffung, Verarbeitung und Vertrieb aufgebrochen wird. Den Abschluss bildet ein Kapitel, in dem die Grundlagen der Schlachtkörperkalkulation und seiner Verwertung in der Verarbeitung dargestellt werden. Diese Kalkulationen sind so ausgerichtet, dass sie dem Direktvermarkter zeigen, wie er kleine Mengen von Schlachtkörpern so aufarbeiten kann, dass alle Edel- und Verarbeitungsteilstücke vollständig ihrem Wert entsprechend genutzt werden können. Wirtschaftlichkeit und Nachhaltigkeit scheinen also insofern durchaus vereinbar zu sein.
Der Band richtet sich an landwirtschaftliche Berater, landwirtschaftliche Untersuchungsämter und Prüfinstitutionen, an Mitglieder und Mitarbeiter von Ökoverbänden und Verbandsvertreter des Fleischbereiches insgesamt, sowie an Lehrende und Lernende der Agrar- und Ernährungswissenschaften, der Veterinärmedizin und verwandter Bereiche.

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