Arch. Tierz., Dummerstorf 43 (2000) 1, 69-77

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Effects of genetic control of subcutaneous fat deposition via using restricted selection indexes on live performance and carcass characteristics of Pekin ducklings

Summary

Estimates of phenotypic and genetic parameters for live performance and detailed dissection traits of body components and carcass tissues in Pekin ducks were calculated and used to construct selection indexes. The expected reduction in potential gain in live weight, dressing percentage and carcass characteristics resulting from restricting change in subcutaneous fat level to zero were assessed. The aggregate genotype measurements were weight at slaughter, dressing percentage and percent subcutaneous fat. The index measurements were weight at hatching, weight at slaughter, weight gain, breast width, breast length and breast circumference.

The restricted indexes as compared with the unrestricted would lead to minimum reduction in potential gain of 29.4% in total net merit, 96.4% in weight at slaughter, 49.0% in dressing percentage, 74.0% in dissected side weight and 75.0% in muscle to bone ratio. The potential reduction in percent abdominal fat and percent bone in side was decreased by at least 38.5% and 80.2%, respectively. Absolute genetic response results showed that selecting for breast width alone (r_{TI} = 0.79) would be recommended for birds with substandard levels of SCF, whereas use of the restricted index containing weight at hatching and breast width (r_{TI} = 0.54) would be advised for individuals with standard fatness.

Key words: Pekin ducklings, live performance, carcass attributes, genetic parameters, restricted selection indexes

Zusammenfassung

Titel der Arbeit: **Möglichkeiten der Reduzierung des subkutanen Fettes bei Pekingenten durch Indexselektion**

Es wurden phänotypische und genetische Parameter von 16 Lebendgewicht-, Körperform- und Schlachtmerkmalen und deren Beziehungen untereinander bei Pekingenten in Ägypten geschätzt. In die Konstruktion und die Effektivitätsprüfung von Selektionsindizes mit und ohne Restriktion gingen alle wirtschaftlich bedeutungsvollen und entsprechend ihres ökonomischen und genetischen Wertes gewichteten Merkmale ein. Verglichen und diskutiert wurden mehrere Indexvarianten unter dem Aspekt ihrer Auswirkungen auf den jährlichen Zuchtfortschritt bezüglich einzelner Merkmale, insbesondere der Reduzierung des subkutanen Fettgehaltes.

Schlüsselwörter: Pekingente, Lebendgewicht-, Körperform- und Schlachtmerkmale, genetische Parameter, Selektionindizes

Introduction

The carcass fatness pattern that includes proportionately excessive subcutaneous fat generally represents wasted dietary energy (WEBSTER, 1977; LIN et al.,1980), reflects poor management and breeding program (FOWLER et al., 1976; HEATH et al., 1980, LECLERCQ, 1987; LILBURN, 1987) and could result in a wasted product, both quantitatively and qualitatively (KAUFFMAN, 1982). The importance of restraining the subcutaneous fat to certain levels is still debatable and its impact on the live weight and carcass desirability remains to be demonstrated. The aim of the present paper was to test on Pekin ducks the hypothesis that reduction in potential gain in live weight, dressing percentage and other carcass compositional traits would be expected with use of selection indexes restricting changes in subcutaneous fat level to zero.

Material and Methods

Source of data. Sixty-one male and thirty-five female Pekin ducklings progeny of eight sires (twelve per sire) from the experimental poultry farm of the Faculty of Agriculture, Tanta University were used in the present study. The progeny were produced from one spring hatch. The ducklings were housed in temperature-controlled battery brooders for the first two weeks, after which they were reared on a litter-floored pens under uniform conditions. All ducklings received feed and water *ad. libitum*. The diet contained approximately 22% protein and a metabolizable energy of 2900 Kcal/kg from hatching to 10 weeks (slaughter age).

Traits considered. The weight of the birds were recorded at hatching (V1) and at slaughter (V2) permitting the calculation of weight gain (V3). Prior to killing, the following measurements were taken: breast width (V4), breast length (V5) and breast circumference (V6), as described by SWATLAND (1979). The birds were killed by severing the carotid artery and jugular veins. The head was removed at the atlanto-occipital articulation. Heart, liver, and gizzard were separated and their sum of weights 'giblets' was taken (V7). The weight of carcass (without giblets) was recorded (V8). The abdominal fat was removed around the cloaca, gizzard and intestines and weighed (V9). Carcasses stored at –20 °C, were transferred to the Meat Laboratory of the Faculty of Agriculture, Ain Shams University for dissection. They were thawed for approximately 8 hrs (at 5 °C) while being in their bags. The dissected right side weight (V10) was calculated as sum of muscle (V11), subcutaneous fat including skin (V12), intermuscular fat (V13) and bone (V14). This permitted the calculation of muscle: bone ratio (V15) and muscle: fat ratio (V16).

Parameters estimation. The data used for parameters estimation and selection index construction included six live performance traits representing the available sources of information (V1 through V6) and nine slaughter traits (V7 through V16).

The genetic parameters of the traits were estimated from sire components of variance and covariance by the least squares and maximum likelihood program (HARVEY, 1990), according to the following mixed model:

$$\mathbf{Y_{ijk} = \mu + F_i + S_j + e_{ijk}}$$

where:

Y_{ijk} = a trait measurement taken on the k th bird in the ij th subclass;

μ = an effect common to all birds;

F_i = a random effect of the i th sire;

S_j = a fixed effect of the j th sex;

e_{ijk} = a random error assumed N.I.D. $(0, \sigma_e^2)$.

Definition of net income. The breeding objective was to maximize the value of net income (revenue - cost) for each bird. The revenue was calculated as carcass weight (kg) * price (LE /kg) according to subcutaneous fat score based on a preliminary market study. For scores A, B and C where SCF level was respectively, < 20%, 20-25% and > 25%, the price (LE/kg) was 8.00, 7.25 and 6.25, repectively. The cost of production was calculated as the sum of purchase of duckling (LE 1.10/duckling), purchase of feed (LE 0.75/ kg feed consumed during the 10-week period), other operating costs (LE 1.10/duckling) and non-operating expenses (LE 0.60/kg live weight at 10 weeks of age).

The aggregate genotype, economic values and selection indexes. Net income was regressed on several combinations of the biological measurements. The highest R^2, 0.69, was obtained when weight at slaughter, dressing percentage and percent subcutaneous fat were combined in the multiple regression equation. The net income was regressed on these traits and the standard partial regression coefficients served as estimates of the economic values. The six live performance traits (V1 through V6) were used in different combinations to compute (CUNNINGHAM et al., 1970) ten selection indexes with or without restricting change in percent subcutaneous fat to zero.

Results and Discussion

(A) Heritabilities

Heritability estimates (h^2) for live performance and slaughter traits are presented in Table 1. The heritability is higher for breast width (0.69) than for breast length (0.48,

Table 1
Means ($\bar{x}$), phenotypic standard deviation (σ_P) and heritabilities (h^2) for live performance and slaughter traits (Mittelwerte, phänotypische Standardabweichung und Heritabilitäten für Lebend- und Schlachtmerkmale)

	$\bar{x}$	σ_P	h^2
Live performance data			
V1 Weight at hatching, g	45.0	5.4	0.64
V2 Weight at slaughter, g	1689.6	208.9	0.28
V3 Weight gain, g/day	23.5	3.0	0.27
V4 Breast width, cm	13.4	1.1	0.69
V5 Breast length, cm	12.1	0.8	0.48
V6 Breast circumference, cm	26.2	1.7	0.27
Slaughter data			
V7 (Giblets wt/slaughter wt), %	7.52	0.82	0.70
V8 (Carcass wt/slaughter wt), %	54.57	3.66	0.59
V9 (Abdominal fat wt/slaughter wt), %	0.31	0.13	0.41
V10 Side (muscle + fat + bone) wt, g	463.0	75.8	0.47
V11 Muscle in side, %	53.48	2.47	0.31
V12 Subcutaneous fat in side, %	22.03	3.59	0.41
V13 Intermuscular fat in side, %	2.72	0.83	0.12
V14 Bone in side, %	21.77	2.82	0.39
V15 Muscle : bone ratio	2.49	0.30	0.39
V16 Muscle : fat ratio	2.24	0.51	0.26

Table 1; 0.50 PINGEL et al., 1969) or breast circumference (0.27).
The heritability estimates for weight at hatching (0.64, Table 1; 0.49, EL-SAYIAD et al., 1988) are much higher than the values obtained for weight at slaughter (0.28, Table 1; 0.31, SOCHOCKA and WEZYK, 1971; 0.28, PINGEL and JUNG, 1979, 0.35 PINGEL and HEIMPOLD, 1983). The h^2 value of 0.27 for weight gain is much lower than the estimate of 0.73 obtained in the Pekin ducks sample investigated by CLAYTON and POWELL (1979).
The h^2-value for per cent abdominal fat in ducks seems to be moderate (0.41, Table 1). Dressing percentage is less heritable in Pekin ducks (0.59, Table 1) than in Muscovy ducks (0.93, PILLA, 1974) and carcass weight is less heritable in the present sample of Pekin ducks than in that of CLAYTON and POWELL (1979) (0.74). Carcass compositional traits were moderately heritable (0.26 to 0.47) with the only exception of percent intermuscular fat in side (0.12).

(B) Correlations

The phenotypic and genetic correlations among traits are given in Table 2.

Phenotypic association among index traits. Measures of breast conformation were positively correlated with one another (0.25 to 0.65), indicating that breast width could suitably replace breast length or breast circumference as index trait. The breast conformation was more strongly related to weight at slaughter (0.53 to 0.82) or to weight gain (0.53 to 0.83) than to weight at hatching (-0.09 to +0.02). The correlation between weight gain and weight at slaughter of 1.00 implies that the inclusion of both traits in one index is of no use.

Phenotypic and genetic association among individual traits in aggregate breeding value. The basic traits (i.e. those having economic values) were strongly intercorrelated positively (r_G = 0.82 to 0.89; r_p = 0.52 to 0.74), implying that restricting change in per cent subcutaneous fat to zero would lead to considerable genetic reduction in weight at slaughter and dressing percentage. The basic traits appeared to be strongly correlated positively with dissected side weight, per cent intermuscular fat in side and muscle to bone ratio, but negatively correlated with per cent muscle in side and per cent abdominal fat in body. The two latter traits were practically independent (r_G = -0.02; r_p = -0.04).

Genetic association between individual traits in aggregate breeding value and those in index. The dressing percentage and per cent subcutaneous fat were highly correlated positively with breast width (0.90 and 0.58, respectively) and weight at slaughter (0.89 and 0.82, resp.). The breast width and weight at slaughter were positively correlated with one another (0.54) and with weight gain (0.57 and 1.00, resp.), dissected side weight (0.68 and 0.99, resp.) and per cent intermuscular fat in side (0.14 and 0.38, resp.) and negatively correlated with per cent bone in side (-0.75 and -0.88, resp.). Whereas per cent muscle in side was practically independent of breast width (-0.01), it was moderately correlated negatively with weight at slaughter (-0.28).

Table 2
Coefficients of phenotypic correlation (above diagonal) and genetic correlation (below diagonal) among live performance and slaughter traits (Phänotypische Korrelationskoeffizienten (oberhalb der Diagonalen) und genetische Korrelationskoeffizienten (unterhalb der Diagonalen) zwischen Lebend- und Schlachtmerkmalen)

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16
Live performance data																
V1 Weight at hatching, g	....	0.01	-0.02	-0.09	0.02	-0.07	-0.22	0.01	-0.09	0.02	0.03	0.01	0.14	-0.08	0.14	-0.02
V2 Weight at slaughter, g	0.33	....	1.00	0.63	0.53	0.82	-0.27	0.52	-0.10	0.95	-0.30	0.74	0.51	-0.80	0.66	0.67
V3 Weight gain, g/day	0.29	1.00	....	0.64	0.53	0.83	-0.26	0.52	-0.10	0.94	-0.30	0.73	0.51	-0.80	0.66	-0.68
V4 Breast width, cm	-0.55	0.54	0.57	....	0.25	0.65	-0.16	0.56	-0.03	0.68	-0.19	0.54	0.33	-0.61	0.50	-0.48
V5 Breast length, cm	1.00	-0.05	-0.10	-0.23	....	0.45	-0.15	0.37	-0.04	0.53	0.03	0.31	0.09	-0.44	0.42	-0.25
V6 Breast circumference, cm	-0.22	0.98	1.00	1.00	-0.42	....	-0.16	0.56	-0.12	0.84	-0.13	0.59	0.38	-0.73	0.64	-0.51
Slaughter data																
V7 (Giblets wt/slaughter wt), %	-0.84	-0.85	-0.82	0.27	0.08	0.27	....	-0.19	0.13	-0.28	0.00	-0.18	-0.14	0.27	-0.27	0.14
V8 (Carcass wt/slaughter wt), %	0.01	0.89	0.90	0.90	0.39	0.90	-0.02	....	0.01	0.77	-0.20	0.64	0.40	-0.74	0.66	-0.57
V9 (Abdominal fat wt/slaughter wt), %	-0.37	-1.00	-1.00	0.00	-0.31	-0.87	0.82	-0.26	....	-0.07	-0.04	0.04	0.02	-0.02	0.04	-0.03
V10 Side (muscle + fat + bone) wt, g	0.23	0.99	1.00	0.68	0.17	0.96	-0.53	0.94	-0.99	....	-0.32	0.80	0.54	-0.88	0.74	-0.73
V11 Muscle in side, %	-0.42	-0.28	-0.26	-0.01	0.20	-0.18	0.97	-0.20	-0.02	-0.28	....	-0.75	-0.38	0.16	0.17	-0.82
V12 Subcutaneous fat in side, %	-0.37	0.82	0.81	0.58	0.29	0.79	-0.66	0.94	-0.50	0.90	-0.65	....	0.58	-0.75	0.50	-0.95
V13 Intermuscular fat in side, %	1.00	0.38	0.35	0.14	0.16	0.10	-1.00	0.54	-0.21	0.52	-1.00	1.00	....	-0.68	0.56	-0.67
V14 Bone in side, %	-0.32	-0.88	-0.89	-0.75	-0.56	-0.87	0.32	-1.00	0.69	-1.00	0.36	-0.98	-0.27	....	-0.93	0.67
V15 Muscle : bone ratio	0.30	0.86	0.86	0.79	0.76	0.84	-0.06	1.00	-0.70	0.99	-0.14	0.87	-0.09	-0.97	....	-0.39
V16 Muscle : fat ratio	-0.45	0.73	-0.59	-0.35	-0.09	-0.55	0.92	-0.72	0.40	-0.69	-0.81	-0.98	-1.00	0.73	-0.55	....

(C) Economic values

The economic values were estimated at LE 7.0 x 10^{-4} per gram weight at slaughter (WS), LE 1.1 x 10^{-2} per 0.01 dressing percentage (DP) and LE -8.7 x 10^{-2} per cent subcutaneous fat (SCF). Therefore, the true breeding value (T) is:

$$\mathbf{T = 7.0 \times 10^{-4}\, g_{WS} + 1.1 \times 10^{-2}\, g_{DP} - 8.7 \times 10^{-2}\, g_{SCF}}$$

where g is the additive genetic value for the considered trait, ($\sigma_T = 21.60$).

Table 3

Weighing factors (b-value), value of each trait* (in parentheses) and accuracy of selection (r_{TI}) in various index alternatives** (Wichtungsfaktoren, Merkmalswerte und Selektionsintensität bei verschiedenen Indexvarianten)

Alter-native	Index No.	b-value						r_{TI}
		Breast Width	Breast length	Breast circumference	Weight at Hatching	Weight at slaughter	Weight gain	
i	I_1	15.06 (30.69)	2.40 (0.46)	1.49 (0.30)	-0.51 (1.14)	.....	-1.27 (0.60)	0.80
	I_2	15.68 (32.39)	2.45 (0.63)	1.64 (0.40)	....	-0.02 (0.77)	.....	0.80
ii	I_3	.....	......	.....	-0.33 (1.31)	......	3.46 (66.33)	0.50
	I_4	.....	......	.....	......	0.05 (100)	......	0.48
	I_5	14.61 (32.21)	1.26 (0.15)	0.21 (0.01)	....	......	......	0.79
	I_6	15.05 (100)	......	.....	......	......	......	0.79
iii	I_7	14.88 (78.77)	.....	.....	-0.41 (0.79)	.....	.....	0.80
	$I_{7(SCF)}$	5.45 (98.47)	.....	.....	-1.78 (0.00)	.....	.....	0.54
	I_8	16.56 (40.13)	.....	.....	.....	-0.01 (0.00)	.....	0.79
	$I_{8(SCF)}$	6.92 (94.57)	.....	.....	.....	-0.04 (0.00)	.....	0.31

* Per cent reduction in the rate of overall genetic gain if the trait is omitted.

** Alt. (i): full index, Alt. (ii): uniform, reduced indexes, Alt. (iii): mixed reduced indexes with or without restriction.

(D) Indexes

Table 3 gives the b-values, the relative value for each trait and the r_{TI}-values representing the multiple or simple correlation of index with genetic value for net merit. Breast width seems to be the most valuable source of information in the indexes considered. This is due to its strong genetic relations with the basic traits (0.54, with weight at slaughter; 0.90, with dressing percentage; 0.58, with per cent subcutaneous fat). Its relative value ranged between 30.7 and 78.8% in the unrestricted indexes and attained 94.6 and 98.5% in the restricted indexes, ($I_{7(SCF)}$ and $I_{8(SCF)}$), respectively. The relative values of breast length, breast circumference, weights at hatching and at slaughtering and daily gain in the most accurate indexes (I_1, I_2, I_5, I_6, I_7 and I_8) did not exceed 1.1%.

Indexes accuracy. The six unrestricted indexes involving breast width were the most accurate (r_{TI} = 0.79 to 0.80). Selecting for breast width alone (I_6) would be as efficient as selecting for the full index in its two combinations (I_1 and I_2). Selection for weight traits alone would create a remarkable reduction in accuracy (r_{TI} = 0.50 for I_3 and 0.48 for I_4) demonstrating that little can be gained by selection for these traits alone without information on breast conformation. Restricting change in per cent subcutaneous fat to zero through use of $I_{7(SCF)}$ and $I_{8(SCF)}$ would cause, respectively, 32.5 and 60.8% reduction in accuracy of selection since per cent subcutaneous fat is more related genetically to weight at slaughter (0.82) than to weight at hatching (-0.37).

Genetic response. Results of the expected outcome in total merit and individual traits for I_6, I_7, $I_{7(SCF)}$, I_8 and $I_{8(SCF)}$ are given in Table 4.

Table 4
Expected genetic changes per generation in total merit and individual traits (intensity of selection = 1.0)
(Ausgewiesener genetischer Fortschritt per Generation (insgesamt) und Einzelmerkmale)

	Indexes*				
	I_6 (BW)	I_7 (WH, BW)	$I_{7(SCF)}$ (WH, BW)	I_8 (WS, BW)	$I_{8(SCF)}$ (WS, BW)
Total merit, L.E.	0.17	0.17	0.12	0.17	0.07
Basic traits					
Weight at slaughter, g	49.3	44.8	1.6	45.5	-17.4
Dressing percentage	2.09	2.04	1.04	2.09	0.70
Subcutaneous fat in side, %	1.09	0.98	0.00	1.05	0.00
Related traits					
Weight at hatching, g	-1.9	-2.3	-3.7	-2.2	-3.2
Weight gain, g/day	0.73	0.67	0.07	0.67	-0.22
Giblets, %	-0.77	-0.70	-0.01	-0.80	-0.51
Abdominal fat, %	-0.12	-0.12	-0.04	-0.13	-0.08
Dissected side weight, g	29.0	27.3	7.1	27.8	-1.3
Muscle in side, %	-0.02	0.04	0.37	0.01	0.24
Intermuscular fat in side, %	0.04	0.01	-0.17	0.03	-0.04
Bone in side, %	- 1.08	-1.00	-0.19	-1.06	-0.21
Muscle : bone ratio	0.12	0.12	0.03	0.12	0.03
Muscle : fat ratio	- 0.07	-0.06	0.04	-0.07	0.03

* BW = breast width; WH= weight at hatching; WS= weight at slaughter; SCF= per cent subcutaneous fat.

Selecting for the unrestricted indexes (I_6, I_7 and I_8) should lead to increased net merit of LE 0.17 through the production of extra weight at slaughter (44.8 to 49.3 g) with higher dressing percentage (2.04 to 2.09%) to overcome the reduction from over fatness (0.98 to 1.09%). Increases in daily gain (0.67 to 0.73 g/day) and dissected side weight (27.3 to 29.0 g) could also be expected. The small change in per cent muscle in side is of little consequence since enough extra muscle to bone ratio of 0.12 unit is expected to result. Fat would be expected to decrease abdominally and increase intermuscularly with no great change in muscle to fat ratio.

As compared to their unrestricted forms (I_7 and I_8), the restricted indexes $I_{7(SCF)}$ and $I_{8(SCF)}$ would lead to obvious reduction in potential gain (Figure). Minimum reduction of 29.4% in total net merit, 96.4% in weight at slaughter, 89.6% in weight gain, 49.0% in dressing percentage, 74.2% in dissected side weight and 75.0% in muscle to bone ratio would be resulted. The potential reduction in per cent abdominal fat and per cent bone in side should be decreased by at least 38.5% and 80.2%, respectively.

Based on the absolute genetic response results (Table 4). It appears that if it is desired to optimize selection for the given aggregate genotype on condition that no genetic change would occur in percent SCF, individuals with standard levels of SCF could be selected using the index

$$I_{7(SCF)} = -1.78 \text{ Weight at hatching} + 5.45 \text{ Breast width } (r_{TI} = 0.54)$$

as it would lead to no reduction in live body weight or carcass weight. In case of substandard levels of SCF, the single factor index

I_6 **= 15.05 Breast width** **(r_{TI} = 0.79)**

would be recommended but with precaution as it is expected to result in a genetic increase in per cent subcutaneous fat of 1.09 unit after one round of selection.

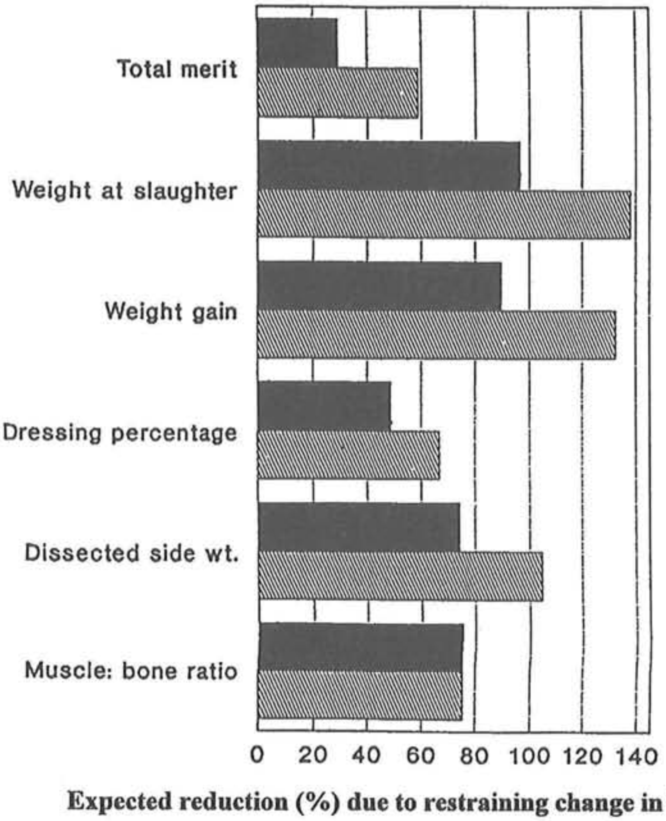

Figure: Expected reduction in potential gain in total merit, weight at slaughter, weight gain, dressing percentage, dissected side weight and muscle : bone ratio resulting from restricting change in subcutaneous fat (SCF) to zero. ■ $I_{7(SCF)}$ and □ $I_{8(SCF)}$ compared to their respective unrestricted forms, I_7 and I_8 as ((Restricted – unrestricted) / unrestricted, %)

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Received: 30.11.1998

Accepted: 09.07.1999

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Tierzucht in den Tropen und Subtropen, Band 5 des Handbuches der Landwirtschaft und Ernährung in den Entwicklungsländern

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2. völlig neu bearbeitete Auflage, 452 Seiten, 91 Tabellen, 23 Farbfotos, 95 s/w Fotos, Verlag Eugen Ulmer, Stuttgart, 1999, ISBN 3-8001-3204-4, 248,00 DM; 1810,00 ÖS; 221,00 SFr

Mit diesem Buch liegt der 5. und letzte Band des „Handbuch der Landwirtschaft und Ernährung in den Entwicklungsländern" vor. In der völlig neu bearbeiteten und erweiterten 2. Auflage werden Stand und Perspektive der Tierzucht und -haltung in den Tropen und Subtropen im Hinblick auf die Situation der in diesen Regionen hauptsächlich vertretenen Entwicklungsländer dargestellt. Die Herausgeber entsprechen mit diesem Buchtitel einem dringenden Bedürfnis, welches einerseits aus dem stetig steigenden Bedarf an tierischen Nahrungsmitteln auch tierischen Ursprungs und andererseits dem Umfang, der Regionalisierung und der Entwicklung der Haustierbestände in diesen Ländern resultiert. Herausgeber und das namhafte Autorenkollektiv verfügen über hohe wissenschaftliche Fachkompetenz mit z.T. langjährigen Erfahrungen aus Tätigkeiten in Ländern dieser Regionen.
Anliegen dieses Buches ist die Darstellung von Gegebenheiten, Engpässen und Potentialen der tierischen Produktion in diesen Ländern, ihrer vielfältigen und sich gegenseitig beeinflussenden klimatischen, technischen, sozialen und wirtschaftlichen Faktoren, die auf die Züchtung und Haltung landwirtschaftlicher Nutztiere Einfluß nehmen - und das ist den Autoren hervorragend gelungen. Die Besonderheit des Buches liegt neben der Darstellung der Produktionstechnik bei den in den Tropen und Subtropen gehaltenen Nutztierarten, in der Komplexität der länder- und tierartenübergreifenden Information spezieller Probleme in der Tierproduktion. Dieser Vorzug wird bei der Betrachtung der jeweils am Ende jedes Kapitels angefügten umfangreichen Literaturverzeichnisse besonders deutlich. Das Buch ist übersichtlich in tierartenübergreifende Problemdarstellungen, die Managementsituation bei den wesentlichen Nutztierarten und Fragen der Weidewirtschaft gegliedert. Beginnend mit dem Stand der Nutztierproduktion in der Welt, folgt der Hauptabschnitt zu den speziellen Problemen der Nutztierproduktion in den Tropen und Subtropen, darunter Klimafaktoren und Adaptation, Nährstoffversorgung und Futterverfügbarkeit, Tierkrankheiten und Kontrollmaßnahmen, Züchtung und die Förderung der Tierproduktion. Ein weiterer umfangreicher Hauptteil ist der Produktionstechnik bei den Nutztierarten: Rind, Büffel, Schaf, Ziege, Equiden, Kameliden, Schwein, Geflügel, Kaninchen, Meerschweinchen und Bienen gewidmet. Bei den jeweiligen Tierarten finden sich u.a. Informationen zu Leistungen, Rassen, Zuchtmaßnahmen, spezieller Produktionstechnik, Fütterung, Krankheiten usw. Ein besonderes Gewicht erhält die kritische Betrachtung der technischen Managementpraktiken unter Berücksichtigung sozio-ökonomischer Einflußfaktoren in den überwiegend kleinbetrieblichen Nutzungsformen. Im letzten Buchteil wird die Nutzung von Wild- und Fischbeständen sowie Weiden und die Weidewirtschaft besprochen.
Dieses Buch kann sicher maßgeblich dazu beitragen die Entwicklungsaktivitäten zur nachhaltigen Verbesserung der Tierbestände und Produktionssysteme an diesen Standorten zu forcieren. Der hohe Informationsgehalt wird durch die zahlreichen Tabellen und Abbildungen unterstützt. Es richtet sich in erster Linie an Studierende, Tierzucht- und Agrarfachpersonen und Veterinärmediziner und ermöglicht einen hervorragenden, komplexen Überblick der Gegebenheiten in der tierischen Produktion und deren Potentiale in Entwicklungsländern der Tropen und Subtropen.

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