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FATTENING PERFORMANCE IN BULLS-CROSSBREDS OF CZECH PIED AND BLACK PIED CATTLE WITH BEEF CATTLE BREEDS

VÝSLEDKY VÝKRMNOSTI U BÝKŮ-KŘÍŽENCŮ ČESKÉHO STRAKATÉHO A ČERNOSTRAKATÉHO SKOTU S MASNÝMI PLEMENY

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ABSTRACT: F_1 crossbreds (n = 232) of Czech Pied and Black Pied cattle sired by Hereford characterized by small body framework (HRF), Aberdeen Angus (AA), Limousine (LI), Blonde d'Aquitaine (BA), Charolais (CH), Piemontese (PI), and Belgian Blue (BM) were fattened at a progeny testing station. The control group (n = 51) was represented by Czech Pied bulls (C_1). Some parameters of fattening performance were classified according to the individual genotype of the crossbreds and their dam genotypes – progeny of dual-purpose type dams (C dams) and progeny of dairy type dams (H dams). The highest live weight at the end of the fattening period (500 ± 8 days of age) was found in CH group (597.7 kg, $P \leq 0.01$). The values found in BA, PI, LI, and HRF groups were significantly lower. The highest growth rate and net weight gain were observed in BM group (1 200 g, 699.1 g, resp.) and in CH group (1 199 g, 692.4 g, resp.). The only significant difference ($P \leq 0.01$) between H group and C group was recorded in live weight at 150 days of age. Live weight of H group was higher by 7.6%. As for crossbreds-progenies of C dams, the results of C x CH, C x BM, and C x AA crossbreds were much better as compared to C x HRF, C x BA, and C x LI groups. As for progenies of H dams, the highest ($P \leq 0.05$) live weight at the end of fattening was recorded in H x CH group (583.3 kg). The highest net weight gain (683.4 g) was recorded in H X BA group. The largest differences within the breed classified according to the dam's genotype were established in progenies sired by Limousine and Blonde d'Aquitaine.

beef cattle breeds; crossing; live weight; average daily gain; net weight gain

ABSTRAKT: Masná plemena skotu chovaná v ČR jsou využívána pro produkci kvalitního hovězího masa nejen v čistokrevné formě, ale i při jednoduchém užitkovém křížení s plemenicemi domácí populace skotu. Cílem práce bylo porovnat výkrmové schopnosti býků-kříženců F_1 generace plemenic českého strakatého a černostrakatého skotu s býky hospodářsky významných masných plemen skotu a objektivně tak posoudit výkrmové schopnosti jednotlivých kombinací. Do sledování bylo zařazeno 232 potomků po bycích plemen hereford malého tělesného rámce (HRF), aberdeen angus (AA), limousine (LI), blonde d'aquitaine (BA), charolaise (CH), piemontese (PI) a belgické modré (BM). Kontrolní skupinu (51 kusů) tvořili býci českého strakatého skotu (C_1). Pokus byl realizován ve standardních podmínkách stanice kontroly výkrmnosti skotu při stabilním průměrném denním přírůstku nad 1 200 g a průměrné spotřebě jadrných krmiv 3,2 kg na 1 kg přírůstku. Býci byli ustájeni ve volných stlaných kotcích ve skupinách po 14 kusech. Odchov býků probíhal od 60 ± 8 do 150 ± 8 dnů věku a vlastní zkouška užitkovosti od 150 ± 8 do 500 ± 8 dnů věku. Průměrná délka výkrmu se pohybovala od 497,3 dní (AA) do 505,6 dní (BA). Pro vyhodnocení vybraných ukazatelů výkrmnosti byli kříženci rozděleni podle genotypu matky na skupinu po matkách kombinovaného typu (C) a dojného typu (H). Nejvyšší živou hmotnost při ukončení výkrmu v 500 ± 8 dnech věku ($P \leq 0.01$) měla skupina CH (597,7 kg). Vyšší hmotnosti oproti kontrolní skupině C_1 dosáhla i skupina BM (587,2 kg). Vzhledem k tomu, že rozdíly mezi skupinami nebyly statisticky významné, nebyl efekt užitkového křížení potvrzen. Signifikantně nižší hmotnost měly skupiny BA, PI, LI a HRF (553,3 kg, 542,9 kg, 538,4 kg a 533,8 kg). Intenzita růstu i netto přírůstek byly za období zkoušky užitkovosti nejvyšší u skupin kříženců BM (1 200 g, resp. 699,1 g) a CH (1 199 g, resp. 692,4 g). Nevýznamně nižších hodnot dosáhla skupina AA (1 171 g, resp. 676,1 g) a kontrolní skupina (1 160 g, resp. 672,4 g). Nejnižší hodnoty ($P \leq 0,05$ až 0,01) byly u skupin LI, HRF, BA a PI. Při vytřídění souboru podle genotypu matky byl prokázán významný rozdíl ($P \leq 0,01$) pouze u živé hmotnosti ve 150 dnech věku. Skupina H měla vyšší hmotnost o 7,6 %. Mezi skupinami kříženců po matkách C dosáhli výrazně lepších výsledků ($P \leq 0,01$), s výjimkou živé hmotnosti ve 150 dnech věku, kříženci C x CH, C x BM a C x AA oproti skupinám C x HRF, C x BA a C x LI. Při křížení s plemenicemi H měla významně nejvyšší ($P \leq 0,01$) živou hmotnost ve 150 dnech věku skupina H x LI (195,4 kg) a při ukončení výkrmu ($P \leq 0,05$) kombinace křížení H x CH (583,3 kg). Nejvyšší netto přírůstek ($P \leq 0,01$) byl zjištěn u kombinace H x BA (683,4 g). Největší rozdíly u zvířat v rámci jednoho plemene, rozdělených podle genotypu matky, byly zjištěny u potomstva po bycích LI a BA. U obou skupin byly významně lepší ($P \leq 0,05$ až 0,001) kombinace křížení H x LI a H x BA.

masná plemena skotu; křížení; živá hmotnost; průměrný denní přírůstek; netto přírůstek

INTRODUCTION

More intensive utilization of beef cattle breeds is envisaged for realization of the adequate production of good quality beef in the Czech Republic. Beef cattle breeds will be utilized not only in purebred herds, but also for simple commercial crossing. Therefore fattening performance in the individual combinations of commercial crossing must be estimated objectively with respect to fattening effectiveness parameters.

Crossing of Czech Pied cattle with Hereford cattle in the C.R. is mentioned by numerous authors (Teslík et al., 1988, 1989; Frelich et al., 1985, 1992; Štráfelda, 1992; Voříšková, Frelich, 1996).

Szücz et al. (1995) mention higher weight gain in crossbreds of Hungarian Pied cattle with Hereford – by 28 g and by 127 g as compared to Hungarian Pied and to Hereford, respectively.

Teslík et al. (1994) compared meat efficiency in bulls – F_1 crossbreds of Czech Pied cattle with Aberdeen Angus (AA) and Fleckvieh (Fv). Slaughter weight of AA crossbreds and Fv crossbreds amounted to 535 kg and 532 kg, respectively; mean daily weight gain in the fattening period being 0.991 kg and 0.992 kg, respectively.

Teslík et al. (1991) found the following parameters in the progeny of Limousine bulls: pre-slaughter weight 514.7 kg, average daily gain in the fattening period 1.005 kg, net weight gain 0.482 kg. A significant difference was found as compared to the corresponding values in the control group of Czech Pied bulls (534.6 kg, 0.972 kg, 0.499 kg). Gabriš et al. (1980) demonstrated lower daily gain (0.915 kg) in F_1 crossbreds of Slovakian Pied cattle with Limousine as compared to the Slovakian Pied bulls (0.947 kg). Váchal et al. (1979) and Nosáľ et al. (1991) also mentioned lower values of fattening parameters in the progeny of Limousine sires.

In bulls fattened to higher slaughter weights, high weight gains in Blonde d'Aquitaine cattle were reported by Kaufmann, Chavaz (1989) and Malterre (1986). According to the mentioned references fattening to higher slaughter weight (700 kg) excluding remarkable fatness is recommended for Charolais cattle as well. Bartoň et al. (1995) studied fattening performance parameters in crossbreds of Czech Pied cattle with Blonde d'Aquitaine and Charolais. The highest daily gain was recorded in C x CH crossbreds (1 332 g) – the corresponding values in C x BA crossbreds and in Czech Pied bulls being 1 284 g and 1 145 g, respectively.

Ponížil et al. (1987) found the highest daily gain from birth to slaughter (1038 g) and the highest net gain (615 g) in bulls-crossbreds of Czech Pied cattle with Charolais. Keane (1995) mentions the following daily gains in the crossbreds of Friesian cattle with Charolais bulls fattened under intensive, routine, and extensive regimes: 1 055 g, 802 g, 704 g.

Hruška (1993) found average net gain 654 g in crossbreds of dairy cattle with Piemontese bulls.

Gerhady (1994) recorded net gain 699 g in crossbreds with Belgian Blue cattle.

The good fattening performance of Czech Pied cattle is reported by numerous authors (Župka, Šubrt, 1980; Teslík et al., 1980, 1995; Trojan, Safarová, 1987; Ponížil et al., 1987; Golda et al., 1989, and others).

MATERIAL AND METHODS

Fattening performance was studied in bulls – F_1 crossbreds of Czech Pied and Black Pied cattle with bulls of the following beef breeds: Hereford characterized by small body framework imported to the Czech Republic in 1974 (HRF), Aberdeen Angus (AA), Limousine (LI), Blonde d'Aquitaine (BA), Charolais (CH), Piemontese (PI), and Belgian Blue (BM). The control group consisted of Czech Pied bulls (C_1) – sons of sires controlled by meat efficiency progeny testing.

The experiment was conducted at a progeny testing station Reprogen, a.s., at Planá on Lužnice. In total 283 bulls were tested. In the period of rearing and fattening the number of animals in individual groups was reduced due to necessary slaughterings. Crossbreds with HRF were sired by 9 bulls, CH crossbreds, BM, AA and LI, BA and PI crossbreds were sired by 7, 6, 4, and 3 bulls, respectively. Bulls-crossbreds were reared and fattened simultaneously with tested bulls under standard conditions of the station. Bulls were housed in loose littered stalls in groups (14 head per group).

In the pre-fattening period (60 ± 8 days–150 ± 8 days of age) and fattening period (150 ± 8 days–500 ± 8 days of age) weights at 60, 150, 365, 420, and 500 (± 8 days) of age were controlled. The live weight at 365 and 420 days of age was not observed in all animals. The mentioned values formed the basis for the calculation of average daily gains in the following periods: 60–150 days, 150–365 days, 365–420 days, 420–500 days, 150–500 days of age, and for calculation of net weight gain. In the period of bull efficiency testing the ration guaranteeing the daily gain 1 200 g was fed. The ration was composed of maize silage, clover-grass haylage, and concentrates. The bulls were slaughtered at 500 ± 8 days of age in slaughterhouses located at ca. 15km distance from the testing station. The average age at slaughter is given in Tab. I. Mates of the crossbreds were selected randomly at slaughter. The chosen animals formed the control group of Czech Pied bulls (C_1).

The tested set of crossbreds was assorted according to the individual genotype into 7 groups and according to the mother's genotype into groups after mothers of dual-purpose type (C) and mothers of dairy type (H).

Analysis of variance was used for the statistical processing of results. Differences between the groups

I. Average fattening periods (days) of tested groups

Progeny sired by	n	$\bar{x}$	$s_{\bar{x}}$	F-test
HRF	36	500.6	8.9	1.358
LI	57	502.9	12.1	
PI	15	503.2	6.7	
BA	25	505.6	12.2	
AA	21	497.3	6.4	
BM	18	501.3	7.7	
CH	48	501.0	4.5	
C_1	51	502.8	4.2	

were tested at significance levels $P \leq 0.05$ and $P \leq 0.01$ (F-test) and $P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$ (t-test).

RESULTS AND DISCUSSION

Resultant values of live weight in the fattening period in tested groups are given in Tab. II. The determined differences between individual groups are significant or highly significant in all cases ($P \leq 0.05$ and $P \leq 0.01$).

At 60 days of age, the highest live weight (92.1 kg) was found in the progeny of Charolais sires. This corresponds to the highest birth weight of Charolais calves as compared to other breeds (Štráfelda, 1992). An insignificant reduction of live weight was recorded in BA, BM, C_1, and AA groups. The values found in LI, PI, HRF groups (82.1 kg, 80.1 kg, and 78.7 kg, respectively) were significantly lower ($P \leq 0.05$–0.001).

The onset of the proper performance testing (150 days of age) was characterized by the highest live weight of the control C_1 group (179.6 kg) and CH group (178.7 kg). The differences between the mentioned groups and PI group (18.2 kg and 17.3 kg, resp.) and HRF group (16.8 kg and 15.9 kg, respectively) were statistically significant ($P \leq 0.05$, $P \leq 0.01$). As for the other groups, live weight ranged from 167.3 kg (BM) to 176.6 kg (BA).

At 365 days of age, CH and BM groups (442.6 kg and 441.2 kg), and AA and C_1 groups (425.5 kg and 424.9 kg) were at a comparable level. In the BA group, the average live weight amounted to 412.9 kg. The significantly (P0.01) lower values were found in PI, LI, and HRF groups (384.5 kg, 396.4 kg, 397.4 kg, respectively). A similar tendency was recorded at 420 days of age.

The end of the fattening period (500 days) was characterized by the highest live weight (597.7 kg) of crossbreds with Charolais. Live weight in BM group (587.2 kg) was also higher than the weight of control C_1 group (585.7 kg). The differences were not, however, statistically significant – no positive effect of the commercial crossing of Czech Pied cattle with beef cattle breeds was maintained in the case of live weight at 500 days of age. Live weights were lower by 1.0% in AA group, 5.5% in BA group ($P \leq 0.05$), by 7.3% in PI group ($P \leq 0.05$), by 8.1% in LI group ($P \leq 0.001$) and by 8.9% in HRF group ($P \leq 0.001$) as compared to the control group.

Lower parameters of fattening performance in the progeny of Hereford sires characterized by small body framework correspond to the results published by Teslík et al. (1988, 1989), Frelich et al. (1985, 1992) and Štráfelda (1992).

Low values of Limousine crossbred live weight determined in our study also agree with data mentioned by Váchal et al. (1979), Gabriš et al. (1980) and Nosáľ et al. (1991).

The highest growth potential determined in Charolais crossbreds corresponds to results reported by Malterre (1986), Kaufmann, Chavaz (1989) and Bartoň et al. (1995). The mentioned authors recommend to fatten Charolais crossbreds to higher slaughter weights (ca. 700 kg).

The average daily gains in individual groups are presented in Tab. III and in Fig. 1. In the pre-fattening period (60–150 days), the average daily gain exceeded 1 000 g in C_1 group and LI group only (1 032 g, 1 016 g, resp.). The lowest growth intensity was recorded in PI group (882 g). The differences were not, however, statistically significant.

The first stage of performance testing was characterized by average daily gains higher than 1 000 g in all the groups. This fact reflects more intensive growth potential of the organism until 12 months of age. The differences were statistically significant ($P \leq 0.01$) between the groups showing higher growth intensity (BM – 1 274 g, CH – 1 244 g) and groups with the lowest values (LI – 1 036 g, PI – 1 042 g, BA – 1 091 g).

The interval from 365 days to the end of fattening period was characterized by insignificant differences. In the final stage of fattening period (420–500 days) higher growth intensity in comparison with the preceding stage was found only in PI group (2.68 %) and in C_1 group (3.84 %). Reduction of growth rate in other groups ranged from 0.70% (CH) to 7.92% (HRF). The remarkable reduction of growth intensity in HRF crossbreds supports recommendation of Teslík et al. (1988, 1989), Frelich et al. (1985, 1992) and Štráfelda (1992) to terminate fattening of HRF crossbreds at lower slaughter weights (ca. 500 kg).

As for the complete period of performance testing (150–500 days of age), the highest daily gains were recorded in BM group and CH group (1 200 g, 1 199 g, respectively). The growth rate in AA group (1 171 g) was also higher than the rate in the control C_1 group (1 160 g). Average daily gains of LI, HRF, BA, and PI groups were significantly lower.

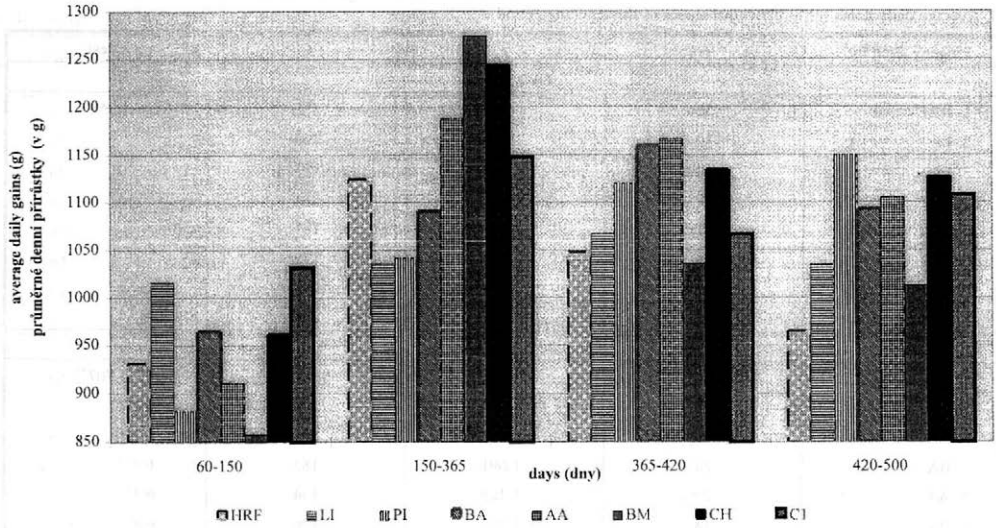
Bartoň et al. (1995) mention higher gains in the C x CH cross combination (by 187 g) and C x BA combination (by 139 g) as compared to the weight gains of Czech Pied bulls (1 145 g). In our study, weight gains in CH group were higher by 39 g and

II. Liveweight (kg) in the fattening period

Progeny sired by	n	$\bar{x}$	$s_{\bar{x}}$	F-test	
60 days					
1. HRF	37	78.7	9.1	6.866^{++}	
2. LI	57	82.1	10.2	$7{:}1^{+++}$	$5{:}2^{+}$
3. PI	12	80.1	9.8	$7{:}2^{+++}$	$4{:}1^{+++}$
4. BA	31	90.4	11.7	$7{:}3^{+}$	$4{:}2^{++}$
5. AA	22	88.1	12.2	$6{:}1^{+++}$	$4{:}3^{+}$
6. BM	18	90.1	9.1	$6{:}2^{+++}$	$8{:}1^{+++}$
7. CH	52	92.1	14.3	$6{:}3^{+}$	$8{:}2^{++}$
8. C_1	40	88.9	11.5	$5{:}1^{++}$	$8{:}3^{+}$
150 days					
1. HRF	36	162.8	25.6	2.166^{+}	
2. LI	57	173.6	28.0	$8{:}3^{+}$	
3. PI	15	161.4	12.3	$8{:}1^{++}$	
4. BA	30	176.6	32.7	$7{:}3^{+}$	
5. AA	21	169.9	17.7	$7{:}1^{++}$	
6. BM	18	167.3	20.6		
7. CH	52	178.7	28.5		
8. C_1	51	179.6	26.3		
365 days					
1. HRF	28	397.4	42.5	4.876^{++}	
2. LI	57	396.4	56.0	$7{:}1^{+++}$	$5{:}2^{+}$
3. PI	13	384.5	55.2	$7{:}2^{+++}$	$5{:}3^{+}$
4. BA	24	412.9	62.5	$7{:}3^{+++}$	$8{:}1^{+}$
5. AA	20	425.5	33.4	$6{:}1^{++}$	$8{:}2^{+}$
6. BM	18	441.2	44.7	$6{:}2^{++}$	$8{:}3^{+}$
7. CH	40	442.6	47.1	$6{:}3^{++}$	
8. C_1	24	424.9	45.3	$5{:}1^{+}$	
420 days					
1. HRF	28	455.0	45.7	4.150^{++}	
2. LI	57	455.1	46.8	$7{:}1^{++}$	$5{:}3^{+}$
3. PI	12	446.1	67.5	$7{:}2^{+++}$	$6{:}2^{+}$
4. BA	23	477.7	62.8	$7{:}3^{++}$	
5. AA	18	491.9	34.5	$7{:}4^{+}$	
6. BM	11	490.9	49.6	$7{:}8^{+}$	
7. CH	27	511.7	48.8	$5{:}1^{++}$	
8. C_1	19	479.1	37.6	$5{:}2^{++}$	
500 days					
1. HRF	36	533.8	38.1	9.146^{++}	
2. LI	57	538.4	48.5	$7{:}1^{+++}$	$8{:}2^{+++}$
3. PI	15	542.9	72.2	$7{:}2^{+++}$	$8{:}3^{+}$
4. BA	25	553.3	59.0	$7{:}3^{++}$	$8{:}4^{+}$
5. AA	21	579.8	34.8	$7{:}4^{++}$	$5{:}1^{+++}$
6. BM	18	587.2	55.1	$6{:}1^{+++}$	$5{:}2^{+++}$
7. CH	48	597.7	56.8	$6{:}2^{++}$	
8. C_1	51	585.7	51.7	$8{:}1^{+++}$	

III. Average daily gains (g) in individual stages of the fattening period

Progeny sired by	n	$\bar{x}$	$s_{\bar{x}}$	F-test	
60–150 days					
1. HRF	36	931	251	1.358	
2. LI	57	1 016	295		
3. PI	12	882	193		
4. BA	30	965	284		
5. AA	21	911	187		
6. BM	18	858	170		
7. CH	52	962	289		
8. C_1	40	1 032	285		
150–365 days					
1. HRF	16	1 125	137	6.707^{++}	
2. LI	56	1 036	192	$6{:}2^{+++}$	
3. PI	13	1 042	234	$6{:}3^{++}$	
4. BA	24	1 091	182	$6{:}4^{++}$	
5. AA	20	1 188	134	$6{:}1^{+}$	
6. BM	18	1 274	196	$6{:}8^{+}$	
7. CH	40	1 244	191	$5{:}2^{++}$	
8. C_1	24	1 148	139	$5{:}3^{+}$	
365–420 days					
1. HRF	28	1 048	216	0.540	
2. LI	57	1 067	360		
3. PI	12	1 120	396		
4. BA	23	1 160	379		
5. AA	18	1 167	176		
6. BM	11	1 036	272		
7. CH	27	1 135	264		
8. C_1	19	1 067	374		
420–500 days					
1. HRF	28	965	278	0.722	
2. LI	57	1 035	449		
3. PI	12	1 150	366		
4. BA	23	1 093	243		
5. AA	18	1 105	214		
6. BM	11	1 013	302		
7. CH	27	1 127	277		
8. C_1	19	1 108	334		
150–500 days					
1. HRF	36	1 060	93	9.029^{++}	
2. LI	57	1 042	124	$6{:}1^{+++}$	$5{:}1^{+++}$
3. PI	15	1 090	195	$6{:}2^{+++}$	$5{:}2^{+++}$
4. BA	25	1 076	109	$6{:}4^{++}$	$5{:}4^{++}$
5. AA	21	1 171	92	$7{:}1^{+++}$	$8{:}1^{+++}$
6. BM	18	1 200	139	$7{:}4^{+++}$	$8{:}4^{+++}$
7. CH	48	1 199	146	$7{:}3^{+}$	$8{:}3^{+}$
8. C_1	51	1 160	137	$7{:}2^{+++}$	$8{:}2^{+++}$



1. Average daily gains (g) in individual stages of rearing and fattening

IV. Average net gain (g) in tested groups

Progeny sired by	n	$\bar{x}$	$s_{\bar{x}}$	F-test
1. HRF	36	609.8	48.3	7.232^{++}
2. LI	57	632.8	69.0	$6{:}1^{+++}$ $8{:}1^{+++}$
3. PI	15	634.3	84.0	$6{:}2^{+++}$ $8{:}2^{++}$
4. BA	25	650.2	83.7	$6{:}3^{+}$ $5{:}1^{+}$
5. AA	21	676.1	48.3	$7{:}1^{+++}$
6. BM	18	699.1	59.7	$7{:}2^{+++}$
7. CH	48	692.4	67.6	$7{:}3^{+}$
8. C_1	51	672.4	65.1	$7{:}4^{+}$

V. Comparison of some parameters of fattening performance in crossbreds-progenies of C genotype

Group	n	$\bar{x}$	$s_{\bar{x}}$	min.–max.	t-test
weight at 150 days of age (kg)					
C	121	166.0	25.3	100–256	3.81^{+++}
H	98	179.6	27.2	110–236	
weight at 500 days of age (kg)					
C	120	559.5	58.4	455–681	0.53
H	90	563.7	54.0	431–693	
daily weight gains from 150 to 500 days (g)					
C	120	1 124	148	665–1 477	1.33
H	90	1 098	131	777–1 451	
net weight gain (g)					
C	114	653.6	76.0	475.0–825.5	0.33
H	84	657.0	64.0	524.9–807.3	

VI. Comparison of some parameters of fattening performance in crossbreds-progenies of C genotype dams

Parameter		1. C x HRF	2. C x LI	3. C x BA	4. C x AA	5. C x BM	6. C x CH
Weight at 150 days (kg)	n	14	39	12	15	18	29
	$\bar{x}$	157.3	162.9	157.9	169.7	167.3	175.2
	$s_{\bar{x}}$	24.2	25.4	26.8	18.8	20.6	28.6
F-test		1.48					
Weigt at 500 days (kg)	n	14	39	11	15	18	29
	$\bar{x}$	531.1	518.8	525.1	588.2	587.2	607.1
	$s_{\bar{x}}$	33.5	40.6	51.4	35.5	55.1	50.2
F-test		17.58^{++}	$4{:}1^{+++}$ $4{:}2^{+++}$	$4{:}3^{+++}$ $5{:}1^{++}$	$5{:}2^{+++}$ $5{:}3^{+++}$	$6{:}1^{+++}$ $6{:}2{+}{+}{+}$	$6{:}3{+}{+}{+}$
Net gains from 150 to 500 days (g)	n	14	39	11	15	18	29
	$\bar{x}$	1 068	1 017	1 052	1 196	1 200	1 234
	$s_{\bar{x}}$	83	123	101	95	139	122
F-test		15.78^{++}	$4{:}1^{+++}$ $4{:}2^{+++}$	$4{:}3^{++}$ $5{:}1^{++}$	$5{:}2^{+++}$ $5{:}3^{++}$	$6{:}1^{+++}$ $6{:}2{+}{+}{+}$	$6{:}3{+}{+}{+}$
Net weigt gain (g)	n	14	39	11	15	18	29
	$\bar{x}$	601.5	606.1	605.8	688.8	699.1	703.0
	$s_{\bar{x}}$	51.2	64.9	67.2	43.9	59.7	65.0
F-test		13.73^{++}	$4{:}1^{+++}$ $4{:}2^{+++}$	$4{:}3^{++}$ $5{:}1^{+++}$	$5{:}2^{+++}$ $5{:}3^{++}$	6:1+++ 6:2+++	$6{:}3^{+++}$

VII. Comparison of some parameters of fattening performance in crossbreds-progenies of H genotype dams

Parameter		1. H x HRF	2. H x LI	3. H x BA	4. H x AA	5. H x PI	6. H x CH
Weight at 150 days (kg)	n	22	18	18	6	10	23
	$\bar{x}$	166.3	195.4	187.9	170.3	162.4	183.0
	$s_{\bar{x}}$	26.3	19.2	31.2	16.4	14.7	28.4
F-test		4.23^{++}	$2{:}5^{+++}$ $2{:}1^{+++}$	$2{:}4^{++}$ $3{:}5^{+}$	$3{:}1^{+}$ 6:5+	6:1+	
Weigt at 500 days (kg)	n	22	18	14	6	10	19
	$\bar{x}$	535.5	578.7	573.4	558.7	550.9	583.3
	$s_{\bar{x}}$	41.3	37.9	57.3	23.9	72.7	64.3
F-test		2.14^{+}	$6{:}1^{++}$ $3{:}1^{+}$	2:1++			
Net gains from 150 to 500 days (g)	n	22	18	14	6	10	19
	$\bar{x}$	1 055	1 095	1 093	1 110	1 110	1 146
	$s_{\bar{x}}$	101	110	114	51	192	167
F-test		0.97					
Net weigt gain (g)	n	22	18	14	6	10	19
	$\bar{x}$	614.8	681.7	683.4	638.3	648.5	674.5
	$s_{\bar{x}}$	46.9	46.6	81.4	44.3	69.4	70.2
F-test		3.53^{++}	$2{:}1^{+++}$ $3{:}1^{++}$	6:1++			

VIII. Parameters of fattening performance in selected groups of crossbreds classified according to dam's genotype

Parameter		C x HRF	H x HRF	C x LI	H x LI	C x BA	H x BA	C x AA	H x AA	C x CH	H x CH
Weight at 150 days (kg)	n	14	22	39	18	12	18	15	6	29	23
	$\bar{x}$	157.3	166.3	162.9	195.4	157.9	187.9	169.7	170.3	175.2	183.0
	$s_{\bar{x}}$	24.2	26.3	25.4	19.2	26.8	31.2	18.8	16.4	28.6	28.4
t-test		1.03		4.81^{+++}		2.65^{+}		0.07		1.01	
Weigt at 500 days (kg)	n	14	22	39	18	11	14	15	6	29	19
	$\bar{x}$	531.1	535.5	518.8	587.7	525.1	573.4	588.2	558.7	607.1	583.3
	$s_{\bar{x}}$	33.5	41.3	40.6	37.9	51.4	57.3	35.5	23.9	50.2	64.3
t-test		0.34		5.25^{+++}		2.12^{+}		1.86		1.62	
Net gains from 150 to 500 days (g)	n	14	22	37	18	10	14	15	6	29	19
	$\bar{x}$	1 068	1 055	1 017	1 095	1 052	1 093	1 196	1 110	1 234	1 146
	$s_{\bar{x}}$	83	101	123	110	101	114	94	51	122	167
t-test		0.40		2.29^{+}		0.91		2.09		2.35^{+}	
Net weight gain (g)	n	14	22	39	18	11	14	15	6	29	19
	$\bar{x}$	601.5	614.8	606.1	681.7	605.8	683.4	688.8	638.3	703.0	674.5
	$s_{\bar{x}}$	51.2	46.9	64.9	46.6	67.2	81.4	43.9	44.3	65.0	70.2
t-test		0.40		4.36^{+++}		2.32^{+}		2.22^{+}		1.51	

gains in BA group lower by 84 g in comparison with C_1 group. As for C x LI combination, Teslík et al. (1991) determined higher average daily gains in the fattening period (1 005 g) as compared to Czech Pied bulls (972 g). Average daily gains in the fattening period of Aberdeen Angus crossbreds and Czech Pied bulls amounting to 991 g and 992 g, respectively, are presented by Teslík et al. (1994). Weight gains higher than 1 000 g were recorded by Keane (1995) in intensive fattening of Charolais crossbreds.

The highest value of net weight gain (Tab. IV) was recorded in the BM group (699.1 g). This value is higher by 26.7 g, i.e. 3.8% than the net gain in control C_1 group. Net weight gains of CH group and AA group were higher than those of C_1 group as well (by 2.9% and 0.5%, respectively). The mentioned differences were insignificant. The lowest net gain was found in HRF group (609.8 g). The net weight gain of BM crossbreds (699 g) mentioned by Gerhady (1994) corresponds to our results. Net weight gains amounting to 615 g in Charolais crossbreds and to 654 g in crossbreds sired by the Piemontese are presented by Poníži l et al. (1987) and Hruška (1993), respectively. On the contrary, Frelich et al. (1992) and Teslík et al. (1991) mention lower values of net weight gain in crossbreds sired by Hereford and Limousine.

Classification of the set according to mother's genotype (Tab. V) demonstrated a significant effect of the dam on crossbreds' live weight at 150 days of age. The difference between C group and H group amounted to 13.6 kg ($P \leq 0.01$). The mentioned difference decreased to 4.2 kg at the end of the fattening period. The differences in average daily gain and net weight gain between C group and H group were not significant, either.

The comparison of fattening performance parameters of crossbreds-sons of C genotype dams classified according to the genotype (Tab. VI) revealed significant differences ($P \leq 0.01$) in live weight at 500 days, in average daily gain, and net weight gain. In all parameters, values determined in C x CH, C x AA, C x BM groups were significantly higher ($P \leq 0.01$–$P \leq 0.001$) than the values found in C x LI, C x BA, and C x HRF groups. Live weight at the end of the fattening period ranged from 587.2 kg to 607.1 kg in C x BM, C x AA, and C x CH groups and from 518.8 kg to 531.1 kg in C x LI, C x BA, and C x HRF groups. The average daily gain was higher by 15.0–17.6% and net weight gain was higher by 12.7–14.4%. It is evident that simple commercial crossing of Czech Pied cattle of dual-purpose type with beef bulls is more effective in the case of Charolais, Belgian Blue, and Aberdeen Angus sires.

In crossbred – progenies of H genotype dams – classified according to the genotype (Tab. VII) the highest live weight at 150 days of age was recorded in H x LI group (195.4 kg, $P \leq 0.01$) and in H x BA group and H x CH group (187.0 kg and 183.0 kg, respectively). The highest live weight at 500 days of age was found in the H x CH group (583.3 kg). This value was higher by 47.8 kg ($P \leq 0.01$) in comparison with the lowest weight (H x HRF group). Average daily gains varied from 1 055 g (H x HRF) to 1 146 g (H x CH) – the differences were not significant. The highest net gains were recorded in H x BA group (683.4 g), H x LI (681.7 g) and H x CH (674.5 g) groups.

Gerhady (1994) mentions slaughter weight 606.9 kg and average daily gain 1 202 g in the crossbreds of Black Pied cattle with Belgian Blue bulls. The reported values were higher by 67.7 kg and 176 g,

resp., as compared to Black Pied bulls. On the contrary, Nosáľ et al. (1995) found the highest average daily gain (1313 g) in the H x BA combination. In our study, average daily gain was lower (1093 g). In the crossbreds of Black Pied cattle with Charolais net weight gain amounting to 622 g is reported by Gerhady et al. (1995). In our study, the net weight gain 674.5 was recorded.

Parameters of fattening performance in individual crossbred groups within one breed are compared in Tab. VIII. In the case of mating dams of dual-purpose type and milk type by beef sires, the largest differences ($P \leq 0.05$, $P \leq 0.001$) were found in LI and BA groups in favour of H x LI and H x BA progenies. In the progeny sired by Aberdeen Angus, a significant difference ($P \leq 0.05$) was found only in net gain value. Net gain in C x AA (688.8 g) was higher by 7.3% than the net gain in H x AA group. As for CH crossbreds, weight gain in the C x CH was higher by 88 g ($P \leq 0.05$). In Hereford sires no significant difference was found in the tested parameters of fattening performance.

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PŘENOS VITRIFIKOVANÝCH EMBRYÍ PRASAT

TRANSFER OF VITRIFIED EMBRYOS OF PIGS

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ABSTRACT: Currently, embryo cryopreservation is a commonly used technique of embryo transfer in the main species of farm animals. Trials with embryo cryopreservation in pigs have not been successful before now. Nagashima et al. (1994) presented a survey reporting on the birth of 14 piglets in total in various trials. Cryopreservation of pig embryos have been very difficult. The method of vitrification – method of mammalian embryo cryopreservation without ice crystals being formed – seems to be convenient for cryopreservation of mammalian embryos. About five days old embryos in the stage of perihatching blastocysts were used for preservation. The preserved embryos were used for laparoscopic transfer to three recipients that received 13, 15 and 15 thawn embryos, respectively. The transfer was not successful; the recipients returned to estrus in 22, 22 and 23 days, respectively. It is therefore difficult to say whether the case was embryonic mortality in the last recipient. Group 2 comprised five recipients in total (2 uninseminated and 3 inseminated ones). Following the transfer of 13 to 16 embryos, conception was observed in one uninseminated recipient (abortion at the end of the 2nd month of gravidity) and one inseminated recipient. Both recipients became pregnant after embryo transfer by vitrification technique described in the paper by Říha (1993). The inseminated pregnant recipient delivered seven piglets, six of them were live-born; three piglets are phenotypically different, born from cryopreserved embryos. This trial enabled us to be among a few stations where cryopreservation of porcine embryos has been successful.

pig; embryo; cryopreservation; transfer; pregnancy; piglet

ABSTRAKT: Synchronizovaným příjemkyním ve dvou skupinách byla laparoskopicky přenesena vitrifikovaná embrya v médiích složených ze 2M sacharózy, glycerolu, dimetylsulfoxidu, etylenglykolu a telecího fetálního séra (Říha et al., 1996). Rozmrazování a příprava embryí k přenosu zahrnovala odmývání v 1M a 0,5M roztoku sacharózy v kompletním médiu vždy po dobu 5 min a následnou kultivaci 30 min před přenosem. V první skupině nezabřezla žádná ze tří příjemkyň; ve druhé skupině byly použity tři synchronizované recipientky v říji inseminované semenem fenotypicky odlišného kance a dvě recipientky neinseminované. Zabřezly celkem dvě příjemkyně – jedna neinseminovaná, u které došlo v průběhu konce druhého měsíce gravidity k abortu, a jedna inseminovaná, která porodila sedm selat, z toho šest živě, z nichž tři byla narozena po přenosu vitrifikovaných embryí. Z návratu příjemkyň do říje lze usuzovat na značný podíl embryonální mortality.

prase; embryo; kryokonzervace; přenos; gravidita; sele

ÚVOD

Využití konzervovaných embryí se nabízí zcela reálně v reprodukci a šlechtění skotu, ovcí a koz. U prasat se po přenosu kryokonzervovaných embryí prozatím narodily ne více než dvě desítky selat. První pokusy byly zcela neúspěšné, ale narození životaschopných selat naznačuje, že i tato cesta může být v chovu prasat reálná.

Cílem práce je zhodnotit úspěšnost přenosu kryokonzervovaných embryí prasat synchronizovaným recipientkám.

Postupy, možnosti a limity kryokonzervace embryí prasat popsali Říha et al. (1996). Možnosti, postupy a prostředky synchronizace cyklů a metod přenosu čerstvých embryí jsou shrnuty v práci autorů Říha et al. (1995).

U prasat byly pokusy s kryokonzervací embryí do nedávné doby neúspěšné. O narození celkem 14 selat z různých experimentů referují Nagashima et al. (1994). Zmrazování prasečích embryí je velmi obtížné.

Charakteristická je pro embrya prasat vysoká senzitivita na zchlazování na teplotu pod 15 °C – jako první tuto skutečnost prokázali Polge et al. (1974), kteří

zchlazovali embrya na teplotu 0 °C, a dále Nagashima et al. (1989a, b) a Niemann (1985) při zchlazení na 10 °C. Plante et al. (1993) později prokázali, že prasečí embrya zchlazená pod 15 °C lyzují v průběhu 12hodinové kultivace po zmrazení a rozmrazení. Toner et al. (1986) dokázali, že vysoká senzitivita prasečích embryí na kryokonzervaci souvisí s vysokým obsahem tuků v cytoplazmě. Tukové sudanofilní kapky, které jsou značně zastoupeny v embryích jedno- až osmibuněčného stadia, jsou ve stadiu blastocysty přítomny ve značně redukovaném množství (Niimura, Ishida, 1980) a k dalšímu poklesu velikosti neutrálních lipidových částic dochází po hatchingu, což patrně koresponduje s vývojovým stadiem embrya, v němž mohou být prasečí embrya mrazena (Nagashima et al., 1992).

Přesto existuje několik prací, které referují o úspěšné kryokonzervaci prasečích embryí při zmrazení do –35 °C nebo –196 °C (Feng et al., 1991; Kashiwazaki et al., 1991a, b; Nagashima et al., 1989b; Fujino et al., 1993).

Hayashi et al. (1989) prokázali, že velká změna v úspěšnosti zmrazování nastává mezi preexpandovanými a postexpandovanými blastocystami a vliv má i plemenná příslušnost. Úspěšnost postupů byla velmi variabilní a nebylo dosaženo jejich opakovatelnosti.

Metoda vitrifikace, tj. metoda kryokonzervace embryí savců bez vytváření krystalů ledu, se ukazuje jako vhodná pro kryokonzervaci savčích embryí. Podle práce autora Rall (1987) a dalších dovoluje vitrifikace rychlé zmrznutí média bez přítomnosti ledových krystalů. Metodou vitrifikace byla úspěšně konzervována embrya laboratorních hlodavců (Dobrinsky et al., 1988; Říha, 1990 a další), králíků (Dobrinsky et al., 1990), ovcí a koz (Schiewe et al., 1991; Říha, 1993; Dobrinsky et al., 1990) a skotu (Massip et al., 1986; Říha, Landa, 1989; Říha et al., 1991; Říha, 1990, 1993).

Nejnovější výsledky o úspěšnosti kryokonzervace embryí prasat v ČR testovaných v podmínkách *in vitro* (mikrostruktura, syntéza RNA) jsou uvedeny v práci autorů Říha et al. (1996).

MATERIÁL A METODY

Synchronizace, odběr a kryokonzervace embryí: Postupem přípravy dárkyň, ošetření embryí a jejich kryokonzervace jsme se podrobně zabývali v naší předchozí práci (Říha et al., 1996). K vitrifikaci byla použita pětidenní embrya ve stadiu perihatching blastocyst.

Přenos vitrifikovaných embryí

ZVÍŘATA

Přenos se uskutečnil ve dvou skupinách.

V 1. skupině byly recipientky-nulliparní prasničky ČVM připraveny kombinovaným ošetřením Evertas-P – Lonza Kouřim (15 dní), PMSG (Sérový gonadotropin, Bioveta Ivanovice na Hané) 1 000 m.j., HCG (Praedyn, Léčiva Praha) 500 m.j. za 76 hodin, LHRH (Supergestran, Léčiva Praha) v dávce 25 mg lecirelinu, tj. 1 ml preparátu za dalších 16 hodin. Asynchronní přenos byl uskutečněn čtvrtý den cyklu (tj. příjemkyně v cyklu o jeden méně než embrya) laparoskopicky (Endoskop Wolf, Německo) u prasniček ve hřbetní poloze po 24hodinovém hladovění. U příjemkyň byla před přenosem provedena sedace a znecitlivění, ošetření kombinací přípravků (Stresnil – Janssen Pharmaceutica Belgie, Hypnodil – Janssen Pharmaceutica Belgie, Narkamon – Léčiva Praha, Procain – Léčiva Praha) v dávkách podle lékopisu, přičemž byla kontrolována ovariální odezva.

ROZMRAZOVÁNÍ EMBRYÍ

K přenosu byla použita embrya vitrifikovaná způsoby popsanými v práci autorů Říha et al. (1996).

V 1. skupině to byla embrya vitrifikovaná postupem, který popsali Říha, Landa (1989), Říha et al. (1991) a Říha (1990, 1993), s 15minutovou ekvilibrací v 10% glycerolu. Odmývání kryoprotektiva probíhalo dvakrát po dobu 5 min v 1M a 0,5M roztoku sacharózy v kondiciovaném kompletním médiu M 199 nebo H-MEMD. Potom byla embrya třikrát promyta v čerstvém médiu a kultivována 30 min před přenosem. K přenosu byla použita embrya, u kterých byla zaznamenána reexpanze blastocelu. Počet embryí přenášených endoskopickou technikou byl 13, 15 a 15 embryí rozdělených do dvou rohů. Embrya natažená ve venae katetru byla umístěna do děložního rohu cca 10 cm za uteratubánní spoj.

Ve 2. skupině byl celkem osmi recipientkám (ČVM) podáván přípravek Regumate v dávce 5 ml denně po dobu 15 dní. Říje byla stimulována podáním 500 m.j. PMSG (Sérový gonadotropin, Bioveta) 24 hodin po skončení zkrmování Regumate. Za dalších 76 hodin bylo příjemkyním aplikováno i.m. 500 m.j. HCG (Praedyn, Léčiva) a za dalších 12 hodin pak LHRH (Supergestran, Léčiva) v dávce 1 ml. Následně byl kontrolován nástup říje a u pěti recipientek byla provedena inseminace stejně jako u dárkyň, tzn. čerstvým semenem kance fenotypicky odlišného plemene. Embrya byla rozmrazována a připravována k přenosu stejně jako v 1. skupině (embrya zmrazená podle práce Říha, 1993, resp. způsoby popsanými v práci Říha et al., 1996). Přenos byl proveden laparoskopicky (Endoskop Wolf) čtvrtý den cyklu, stejným způsobem jako v 1. skupině příjemkyň. Před přenosem byla u recipientek posouzena úroveň ovariální odezvy (počet CL, přítomnost cyst apod.).

K přenosu byla použita embrya vitrifikovaná postupem podle autorů Říha et al. (1991) a embrya v médiu s DMSO a etylenglykolem (Říha et al., 1996). Rozmrazování embryí probíhalo po 5 min v 1,0M a v 0,5M sacharóze v médiu. Potom byla embrya tři-

krát promyta v čerstvém médiu H-MEMD. Morfologie embryí vhodných k přenosu měla stejná kritéria jako v 1. skupině. Embrya byla přenesena do dvou neinseminovaných (13 a 16 embryí) a do tří inseminovaných recipientek (17, 13, 15 embryí). Byl sledován návrat recipientek do říje a u nepřeběhlých byla sonograficky 40. den po říji (Aloka SSD 500, lineární sonda 5 MHz) stanovena gravidita.

VÝSLEDKY A DISKUSE

V 1. skupině bylo třem příjemkyním připraveným kombinací přípravků Evertas P-PMSG-HCG-LHRH přeneseno laparoskopicky 13, 15 a 15 rozmrazených reexpandovaných blastocyst. Příjemkyně se vrátily do říje v pravidelném cyklu.

Ve 2. skupině bylo použito celkem osm recipientek, které byly ošetřeny kombinací přípravků Regumate – PMSG – HCG – LHRH. Embrya byla přenesena do dvou neinseminovaných recipientek a tří recipientek v říji inseminovaných ID kance fenotypicky odlišného plemene. Výsledky jsou shrnuty v tab. I.

Dvě recipientky se přeběhly v délce cyklu 20 dní, jedna byla jalová – při kontrole ovárií při porážce byl shledán anestrický stav, což by snad mohlo svědčit o embryonální mortalitě bez projevu říje.

Zatím provedené postupy kryokonzervace embryí nejsou příliš úspěšné. Výsledky přenosů čerstvých embryí svědčí o vysoké míře embryonální mortality po provedeném přenosu i v průběhu březosti. Podle literárních údajů dochází ke značnému embryonálnímu úhynu i v průběhu gravidity po inseminaci nebo krytí (Newton et al., 1987; Kudláč et al., 1987; Dyck, 1985; Holness, 1982; Elze et al., 1987; Schlieper, Holtz, 1992).

K embryonálnímu úhynu dochází u prasat ve dvou vlnách: první vlna následuje po ovulaci a oplození (Říha, Vejnar, nepublikované výsledky), druhá po tzv. progesteronovém šoku (představuje náhlé snížení hladiny progesteronu v krvi – obvykle 11.–13. den cyklu, u některých zvířat až 25. den). Důsledkem je až 40% mortalita (Dyck, 1985; Holness, 1982; Elze et al., 1987; Schlieper, Holtz, 1992). Citovaní autoři považují tento moment za jeden z rozhodujících v míře embryonální mortality.

Je však možné, že míra embryonální mortality je po provedeném přenosu čerstvých i konzervovaných embryí vyšší. Nasvědčují tomu dosahované výsledky – citace v práci autorů Říha et al. (1995).

Ve 2. skupině bylo použito celkem pět recipientek (dvě neinseminované a tři inseminované). Po přenosu 13 až 16 embryí zabřezla jedna příjemkyně neinseminovaná (abort na konci druhého měsíce gravidity) a jedna inseminovaná. Obě recipientky zabřezly po přenosu embryí vitrifikovaných způsobem, který popsal Říha (1993). Inseminovaná zabřezlá příjemkyně porodila sedm selat, z toho šest živě. Tři selata jsou fenotypicky odlišná, narozená z kryokonzervovaných embryí; tímto výsledkem jsme se zařadili mezi několik málo pracovišť s „úspěšnou" kryokonzervací prasečích embryí.

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I. Morfologický stav perihatching blastocyst po odmytí kryoprotektiv před jejich přenosem příjemkyním a výsledky přenosu (2. skupina) – Morphological state of perihatching blastocysts after cryoprotectors were rinsed and before their transfer to recipients and the results of transfer (group 2)

Ukazatel		Způsob kryokonzervace[8]	
		a)	b)
		Říha (1993)	etylenglykol a dimethylsulfoxid[9]
Rozmrazeno embryí[1]	*n*	51	39
Intaktní embrya[2]	*n*	46	31
	%	90,2	79,5
Přeneseno embryí[3]	*n*	46	31
Počet použitých recipientek[4]	*n*	3	2
– z toho v říji inseminovaných[5]	*n*	2	1
Počet březích recipientek (sonograficky 45. den po říji)[6]	*n*	2[b)]	0
– z toho inseminovaných v říji[7]	*n*	1	0

a), b) – Přesný postup zmrazení je popsán v práci autorů Říha et al. (1996); odmývání kryoprotektiv bylo prováděno po 5 min v 1M a 0,5M roztoku sacharózy v H-MEMD; pak byla embrya třikrát promyta v čerstvém médiu H-MEMD – Complete cryopreservation technique is described in the paper by Říha et al. (1996); cryoprotective medium was rinsed in 5 minutes in 1M and 0.5M saccharose solution in H-MEMD. Then the embryos were rinsed three times in fresh H-MEMD medium

c) – U jedné recipientky neinseminované v říji došlo k nekontrolovanému abortu asi čtyř plodů v období 3. měsíce gravidity – One recipient cow not inseminated in estrus underwent an abortion of about four embryos in the 3rd month of pregnancy

[1]number of thawn embryos, [2]number of intact embryos, [3]number of embryo transfers, [4]number of recipients, [5]of them the number of inseminated ones in estrus, [6]number of pregnant recipients (sonographic detection on 45th day after estrus), [7]of them the number of inseminated ones in estrus, [8]cryopreservation technique, [9]ethylene glycol and dimethyl sulfoxide

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EFFECT OF OESTRADIOL-17β ON PLASMA CALCIUM IN LAYING HENS

VLIV 17β-ESTRADIOLU NA HLADINU VÁPNÍKU V PLAZMĚ NOSNIC

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ABSTRACT: The effect of low doses of oestradiol-17β on plasma levels of calcium and phosphorus in laying hens was examined. The age of birds was 13 months. Water and feed were provided *ad libitum*. Feed was a standard commercial meal (N2) containing 40.44 g calcium/kg and 2.17 g phosphorus/kg. Hens were given an *i.m.* injection of 0.3 mg oestradiol dipropionate/kg body weight ($n = 5$) or 0.03 mg oestradiol dipropionate/kg body weight ($n = 5$) and the control laying hens ($n = 5$) were given an *i.m.* injection of sterile saline. Blood samples were taken from the *vena basilica* immediately before the oestradiol or saline injection and then 1 h, 2 h, 3 h, 24 h and 96 h after treatment to determine the concentration of ions. The calcium concentration in both oestradiol injected groups of hens decreased gradually to the 24 h after treatment ($P < 0.004$). Both doses of oestradiol increased the plasma calcium concentration 72 h after its depression. The calcium concentration in control hens decreased gradually to the 3rd h after saline treatment ($P < 0.002$) and then returned to the pre-treatment level 24 h after saline injection. The plasma level of calcium 24 h after treatment in control hens in comparison with both oestradiol-treated groups was significantly higher ($P < 0.002$). Concentrations of phosphorus in hens treated with 0.3 mg oestradiol or saline fell steadily to the 24th h after treatment ($P < 0.002$) and then returned to the pre-treatment level ($P < 0.002$). The changes in phosphorus levels after injection of 0.03 mg oestradiol were not significant. The results suggest that low doses of oestradiol may induce changes in plasma calcium levels.

hens; oestradiol; calcium; phosphorus

ABSTRAKT: Byl sledován vliv malých dávek 17β-estradiolu na hladiny vápníku a fosforu u nosnic ve věku 13 měsíců. Voda a krmivo byly podávány *ad libitum*. Jako krmivo byla použita standardní krmná směs (N2), která obsahovala 40,44 g vápníku/kg a 2,17 g fosforu/kg. Nosnicím bylo *i.m.* podáno 0,3 mg estradiol dipropionátu na kg živé hmotnosti ($n = 5$) nebo 0,03 mg estradiol dipropionátu na kg živé hmotnosti. Kontrolní skupina ($n = 5$) byla ošetřena fyziologickým roztokem. Krev k stanovení koncentrace iontů byla odebírána z *vena basilica* ihned před podáním estradiolu nebo fyziologického roztoku a dále za 1, 2, 3, 24 a 96 hodin po ošetření. Koncentrace vápníku u obou skupin ošetřených estradiolem v prvních 24 hodinách postupně klesala ($P < 0,004$). Po depresi vápníku vyvolaly obě dávky estradiolu zvýšení jeho koncentrace během 72 hodin. Koncentrace vápníku u kontrolní skupiny v prvních třech hodinách postupně klesala ($P < 0,002$) a za 24 hodin se opět vrátila na úroveň před ošetřením. Hladina vápníku v krevní plazmě 24 hodin po ošetření byla u kontroly průkazně vyšší než u obou skupin ošetřených estradiolem ($P < 0,002$). Koncentrace fosforu u nosnic ošetřených 0,3 mg estradiolu nebo fyziologickým roztokem postupně v prvních 24 hodinách klesala ($P < 0,002$) a potom se vrátila na úroveň před ošetřením ($P < 0,002$). Po podání 0,03 mg estradiolu nebyly pozorovány průkazné změny hladin fosforu. Výsledky naznačují, že změny hladin vápníku v plazmě lze indukovat malými dávkami estradiolu.

nosnice; estradiol; vápník; fosfor

INTRODUCTION

Calcium homoeostasis is achieved by balancing the efficiency of intestinal calcium absorption, renal calcium excretion, and bone mineral metabolism to the animal's calcium requirements (Sommerville et al., 1989). There is a critical control within a very narrow range of circulating calcium in the normal animal. Not less than four endocrine systems (calcitonin, parathyroid hormone, vitamin D_3 and oestrogens) control these processes (Soares, 1984).

Oestradiol has been implicated in the regulation of calcium metabolism in the laying hen through several modes of action. Oestradiol is known to cause an elevation of circulating plasma calcium levels by stimulating the hepatic synthesis of vitellogenin, a major calcium-binding protein in plasma (Guyer et al., 1980). In addition, oestradiol appears to have a direct effect on the synthesis of uterine calcium-binding protein which may be involved in calcium transport across the uterus (Navickis et al., 1979). Active immunization against oestradiol in the laying hen has resulted in

a worse eggshell quality (Tsang, Grunder, 1983). Oestradiol has been considered to act on medullary bone formation because this tissue readily develops in the marrow cavity of male birds treated with oestrogen (Miller, Bowman, 1981). Osteoblasts responsible for forming medullary bone differentiate following oestrogen stimulation (Bowman, Miller, 1986). On the other hand, it has been reported that the differentiation of osteoblasts was suppressed when an oestrogen receptor binding inhibitor was administered simultaneously with oestrogen (Ohashi et al., 1987).

Several researchers have studied the effect of exogenous oestradiol on calcium plasma concentration in poultry. An increase in circulating plasma calcium level in laying hens 6 days after injection of 10 mg oestradiol was observed (Grunder et al., 1980). A similar elevation was found after 12 days of *i.m.* injections of 2 mg oestradiol/kg (Lobaugh et al., 1981). Total blood calcium in turkey hens increased 7 days after two injections of 75 mg oestradiol at 1 week intervals (McMurtry, Frobish, 1981). However, in the studies demonstrating this effect, high doses of oestradiol were administered. The objective of this study was to determine whether low doses of oestradiol may influence the plasma levels of calcium in laying hens.

MATERIAL AND METHODS

Laying hens (ISA Brown) were housed in a temperature-controlled (18 °C) building in individual laying cages (600 cm^2). The light regime was 15-h light and 9-h dark. The age of birds included in the experiment was 13 months. Water and feed were provided *ad libitum*. Feed was a standard commercial meal (N2) containing 40.44 g calcium/kg and 2.17 g phosphorus/kg.

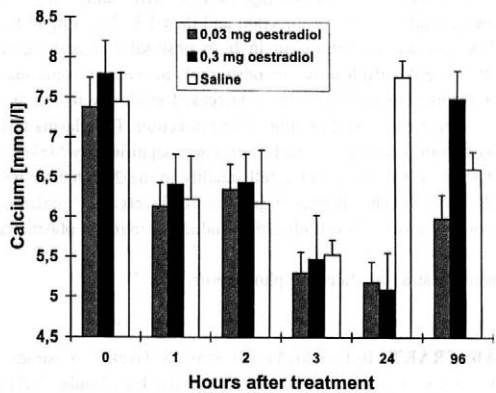
Laying hens were given an *i.m.* injection of 0.3 mg oestradiol dipropionate/kg body weight (n = 5) or 0.03 mg oestradiol dipropionate/kg body weight (n = 5) and control laying hens were given an *i.m.* injection of sterile saline (n = 5). Treatment was conducted 3 to 5 h after oviposition, or approximately 23 to 21 h prior to the next ovulation. Blood samples were taken from the *vena basilica*. Blood was collected into 5-ml heparinized syringes and transferred to heparinized tubes. Samples were stored at 4 °C for 1 h, then the plasma was separated by centrifugation and held at –20 °C until analysis. Each animal was sampled immediately before the oestradiol or saline injection. Blood samples were also collected 1 h, 2 h, 3 h, 24 h and 96 h after treatment to determine ion concentrations.

The calcium concentration was determined by atomic absorption spectrophotometry (H1170, Hilger and Watt). The concentration of phosphorus was determined with an automatic analyzer (Cobas Mira S, Roche).

All results are presented as means ± SEM. The variations of concentrations of ions were examined by analysis of variance and the means were compared using Student's t-test.

RESULTS

Plasma concentrations of calcium in hens treated with 0.3 mg oestradiol decreased gradually during successive blood sampling (Fig. 1). The minimum concentration of calcium was recorded 24 h after oestradiol treatment ($P < 0.004$). Calcium concentration then returned to the pre-treatment level 96 h after oestradiol treatment. The concentration of calcium 96 h, in comparison with 24 h, after injection of 0.3 mg oestradiol increased significantly ($P < 0.004$).



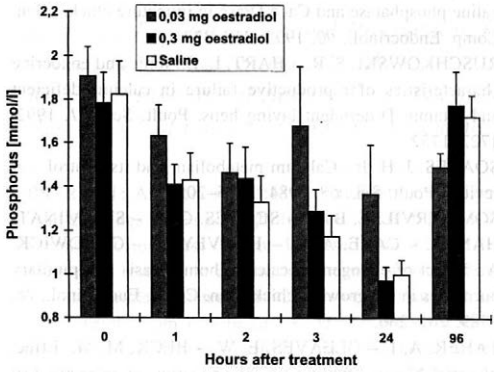
1. Patterns of calcium concentrations in blood plasma in oestradiol--treated and saline-treated laying hens

Plasma concentrations of calcium in hens treated with 0.03 mg oestradiol decreased steadily during successive blood sampling (Fig. 1). The minimum concentration of calcium was measured 24 h after oestradiol treatment ($P < 0.003$). The calcium concentration then returned to the level of 1 h after oestradiol treatment. The increase in calcium concentration 96 h, in comparison with 24 h, after injection of 0.03 mg oestradiol was not significant. There were no significant differences between both oestradiol-treated groups during 24 h after oestradiol treatment. The concentration of calcium 96 h after administration of 0.03 mg oestradiol in comparison with a dose of 0.3 mg oestradiol was significantly lower ($P < 0.01$).

Plasma concentrations of calcium in control hens decreased gradually during successive blood sampling (Fig. 1). The minimum concentration of calcium was measured 3 h after saline treatment ($P < 0.002$). The calcium concentrations in control hens returned to the pre-treatment level 24 h after saline injection, and 96 h after saline treatment they decreased again slightly. The plasma level of calcium 24 h after treatment in control

hens in comparison with both oestradiol-treated groups was significantly higher ($P < 0.002$).

Plasma concentrations of phosphorus in hens treated with 0.3 mg oestradiol decreased steadily during successive blood sampling (Fig. 2). The minimum concentration of phosphorus was measured 24 h after oestradiol treatment ($P < 0.002$). The phosphorus concentration in hens injected with 0.3 mg oestradiol returned to the pre-treatment level 96 h after oestradiol treatment. The concentration of phosphorus 96 h, in comparison with 24 h, after injection of 0.3 mg oestradiol increased significantly ($P < 0.002$).



2. Patterns of phosphorus concentrations in blood plasma in oestradiol-treated and saline-treated laying hens

Plasma concentrations of phosphorus in hens treated with 0.03 mg oestradiol decreased gradually during successive blood sampling (Fig. 2). The minimum concentration of phosphorus was measured 24 h after oestradiol treatment. The changes in phosphorus concentrations after injection of 0.03 mg oestradiol were not significant.

Plasma concentrations of phosphorus in control hens decreased steadily during successive blood sampling (Fig. 2). The minimum concentration of phosphorus was measured 24 h after saline treatment ($P < 0.001$). The phosphorus concentration in control hens returned to the pre-treatment level 96 h after saline treatment. The concentration of phosphorus 96 h, in comparison with 24 h, after saline injection increased significantly ($P < 0.001$). The patterns of phosphorus concentrations were similar for oestradiol (0.3 mg) and saline injected groups.

DISCUSSION

The fall of calcium concentrations in control hens during the first 3 h of blood collection suggests that calcium plasma level may decrease due to serial sampling from the basilic vein. A similar effect of blood sampling on the decrease of calcium concentration was observed in hens bled every four weeks if fed on lower levels of dietary calcium (Taher et al., 1986).

Calcium concentrations in both oestradiol injected groups in contrast to control hens decreased significantly to the 24th h after treatment. This result suggests that oestradiol probably strengthened the decrease of calcium concentration caused by serial blood sampling. Blood removal caused the plasma calcium level to fall and that probably elicited a decrease in the skeleton reserve of calcium. In hens the medullary bone serves as a labile reservoir of calcium (Williams et al., 1991). Birds were shown to respond to oestradiol treatment by forming a medullary bone (Ohashi et al., 1990).

There is a disagreement between the action of low and high doses of oestradiol on plasma calcium levels. In contrast with our results, an increase in plasma calcium levels in poultry was observed after high doses of oestradiol (Grunder et al., 1980; McMurtry, Frobish, 1981; Kaetzel, Soares, 1984). It may be that the degree of change in calcium concentrations is determined by the magnitude of the effect of oestradiol on calcium and bone balance as has been hypothesized in postmenopausal women (Prince, 1994). Hens with a high bone turnover which underwent a large rise in medullary bone mass after oestrogen replacement may be expected to have a large rise in extracellular calcium utilization and therefore a large fall in plasma calcium. On the other hand, the plasma calcium level in hens with a higher medullary bone reserve may be expected to increase after oestrogen administration. It is possible that exogenous oestradiol contributes to a positive calcium balance by a higher intestine calcium absorption (Qin, Klandorf, 1993), by a higher renal calcium reabsorption (Prince, 1995) as well as by stimulating the hepatic synthesis of calcium-binding proteins (Guyer et al., 1980).

Plasma phosphorus concentrations decreased steadily during successive blood samples in the oestradiol and saline injected hens. The decrease of phosphorus concentrations was probably associated with a fall in the calcium level. This is supported by findings that hens fed calcium-deficient diets had lower plasma concentrations of phosphorus than the control hens (Ruschkowski, Hart, 1992). The results indicate that a lower dose of oestradiol probably reduced the decrease of plasma phosphorus levels caused by blood removal.

There is a variety of factors which affect the regulation of plasma calcium concentrations. Up-to-date research results indicate that oestradiol plays an important role in calcium metabolism (Oursler et al., 1993; Qin, Klandorf, 1993; Prince, 1995). Full understanding of the processes whereby oestradiol regulates calcium homoeostasis will be of the utmost significance to the diagnosis and treatment of disorders of calcium metabolism in the laying hens. In conclu-

sion, our results indicate that low doses of oestradiol may induce changes in plasma calcium concentrations.

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VPLYV PLNOTUČNEJ EXTRUDOVANEJ SÓJE NA ÚŽITKOVOSŤ A KVALITU PRODUKCIE NOSNÍC A BROJLEROVÝCH KURČIAT

THE EFFECT OF FULL-FAT EXTRUDED SOYA ON THE PERFORMANCE AND PRODUCE QUALITY IN LAYERS AND BROILER CHICKENS

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ABSTRACT: An inclusion of 11% of full-fat extruded soya in a diet for laying hens increased their egg production from 275 to 283 eggs and egg weight from 60.3 to 61.6 g ($P < 0.05$) with feed conversion 1 : 2.29, which did not change against the control. Cholesterol content decreased from 11.3 to 10.1 mg/g of egg yolk ($P < 0.01$). An inclusion of 5% of dietary full-fat soya resulted in intermediary results with numerical deviations from the control (279 eggs – 60.8 g – 1 : 2.31 – 10.7 mg). Broiler fattening (0–42 days of age) on diet with 14% of full-fat extruded soya on average reflected increased carcass weight from 1.95 to 2.08 kg ($P < 0.05$), with feed conversion 1:1.84 or 1.78. An inclusion of 10% of full-fat soya improved the results in numerical terms only against the control (2.05 kg or 1 : 1.79). The content of polyunsaturated fatty acids (PUFA) in fat increased from control 17 to 31%, the ratio of PUFA : SFA (saturated) from 0.55 to 1.1. Full-fat extruded soya is a highly valuable source of crude protein and fat or energy in poultry nutrition. Its use makes it possible to formulate high-energy types of feed mixtures for poultry without any requirements for special sources of fodder fats. The use of full-fat soya in poultry nutrition enables to modify positively the composition of fat in eggs and poultry meat as well as in foods.

nutrition; laying hen; broiler; full-fat soya; extruded soya; egg production; fattening performance; fat; cholesterol

ABSTRAKT: Podiel 11 % plnotučnej extrudovanej sóje v krmive nosníc zvýšil znášku z 275 na 283 vajec a ich hmotnosť z 60,3 na 61,6 g ($P < 0,05$) pri konverzii krmiva 1 : 2,29 nezmenenej voči kontrole. Obsah cholesterolu sa znížil z 11,3 na 10,1 mg/g žĺtka vajec ($P < 0,01$). Pri podieli 5 % plnotučnej sóje v krmive boli výsledky intermediárne s numerickými odchýlkami od kontroly (279 ks – 60,8 g – 1 : 2,31 – 10,7 mg). Pri výkrme brojlerov (0–42 dní veku) sa pri 14% priemernom podieli plnotučnej extrudovanej sóje v krmive zvýšila jatočná hmotnosť z 1,95 na 2,08 kg ($P < 0,05$), pri konverzii krmiva 1 : 1,84, resp. 1,78. Pri podieli 10 % plnotučnej sóje sa výsledky zlepšili voči kontrole len numericky (2,05 kg, resp. 1 : 1,79). Podiel nenasýtených mastných kyselín (PUFA) v tuku sa zvýšil z kontrolných 17 % na 31 %, pomer PUFA : SFA (nasýtené) z 0,55 na 1,1. Plnotučná extrudovaná sója je vo výžive hydiny vysokohodnotným zdrojom N-látok a tuku, resp. energie. Jej pomocou je možné jednoduchým spôsobom tvoriť vysokoenergetické typy kŕmnych zmesí pre hydinu bez nárokov na osobitné zdroje kŕmnych tukov. Použitím plnotučnej sóje vo výžive hydiny možno pozitívne modifikovať skladbu vajec a mäsa hydiny ako potravín.

výživa; nosnica; brojler; sója plnotučná; sója extrudovaná; znáška; výkrmnosť; tuk; cholesterol

ÚVOD

Pre výživu hydiny má živinová skladba sóje význam najmä z týchto hľadísk:

- vysoký obsah kvalitných bielkovín, ktoré sú hlavným zdrojom lyzínu a s výnimkou sírnych bezpečne pokrývajú aj potrebu ďalších esenciálnych aminokyselín – treonínu, tryptofanu, arginínu;
- vysoký obsah tuku (160–170 g/kg), vďaka ktorému má plnotučná sója asi o polovicu vyššiu energetickú hodnotu ako extrahovaný šrot, prípadne sa vyrovná kukurici ako klasickej energetickej kŕmnej surovine pre hydinu. Pritom minimálne polovicu obsahu tuku v sóji predstavuje kyselina linolová C 18:2, ktorá je pre hydinu esenciálnou živinou. Podľa autorov Halle (1993) a Mátrai et al. (1993) sa táto sku-

točnosť priaznivo prejavuje aj v kvalite tuku vajec a mäsa hydiny ako potravín.

Popri sójovom extrahovanom šrote, ktorý je klasickým bielkovinovým krmivom a ostáva po vyextrahovaní oleja zo semien pre humánny konzum, sa najmä v USA a v západnej Európe používa plnotučná sója spravidla po extrúzii, t.j. po spracovaní vysokým tlakom a vysokou teplotou s následnou expanziou bunečného obsahu.

O výsledkoch experimentálnych prác dokazujúcich možnosti, príp. výhody používania plnotučnej sóje v porovnaní s extrahovaným šrotom u hydiny sú početné údaje v bibliografiách autorov Waldroup (1982) a Monari (1993), ktorý hodnotí výživárske a technologické aspekty plnotučnej sóje u všetkých druhov zvierat. Údaje, ktoré sú blízke našim hospodársko-surovinovým podmienkam, možno čerpať z práce autorov Gundel a Mátrai (1989), vrátane požiadaviek na analytické hodnotenie kvality plnotučnej extrudovanej sóje.

Zo súhrnu citovaných údajov vyplýva, že produkčný účinok plnotučnej sóje u hydiny je za podmienok izoproteínovej zámeny za extrahovaný šrot plne porovnateľný. Limity pre praktické používanie plnotučnej sóje budú skôr v oblasti cenovej, čo bude treba z prípadu na prípadu rešpektovať a brať do úvahy cenový vývoj krmív vrátane zdrojov kŕmneho tuku ako alternatívneho zdroja energie.

MATERIÁL A METÓDA

Spoločnou metodickou zásadou biologických testov bola izoproteínová výživa nosníc a brojlerových kurčiat v skupinových kŕmnych pokusoch (vždy s kontrolnou skupinou a dvoma pokusnými skupinami s opakovanými podskupinami). Pritom sme kombinovali plnotučnú extrudovanú sóju a extrahovaný šrot v kŕmnych zmesiach, v ktorých oba zdroje predstavovali spolu asi polovicu celkového obsahu N-látok. Základ výživy bol u nosníc aj izoenergetický, u brojlerových kurčiat bola priemerná energetická hodnota krmiva kontrolnej skupiny a pokusných skupín v pomere 1 : 1,02 : 1,03. Charakteristika experimentálnych zásahov je uvedená v tab. I.

Znáškový pokus (č. 1) sme uskutočnili s nosnicami komerčného hybrida Hisex hnedý počas 324 dní (vo veku 20–66 týždňov) pri štandardnom klietkovom ustajnení troch sliepok v klietke (600 cm^2/kus) s regulovaným prostredím (dĺžka svetelného dňa 16 h).

Výkrmový pokus (č. 2) sme uskutočnili s kurčatami komerčného hybrida Starbro od vyliahnutia do veku 42 dní pri štandardnom ustajnení na hlbokej podstielke s regulovaným prostredím (dĺžka svetelného dňa 23 h) s hustotou plošného obsadenia 16 ks/m^2. Surovinová skladba a výživná hodnota kŕmnych zmesí skrmovaných v sypkom stave sú uvedené v tab. II, obsah základných živín v plnotučnej extrudovanej sóji použitej v pokusoch je v tab. III.

VÝSLEDKY A DISKUSIA

Z údajov tab. IV vyplýva, že pokusný zásah v III. skupine nosníc (t.j. vyšší podiel plnotučnej sóje v kŕmnej zmesi) štatisticky významne ($P < 0,05$) zvýšil znášku vajec, ich hmotnosť a produkciu vaječnej hmoty na nosnicu pri numericky zlepšených výsledkoch skupiny II (t.j. miernejšieho variantu pokusného zásahu s nižším podielom plnotučnej sóje v krmive). Tento odlišný produkčný účinok pokusných zásahov vznikol v dôsledku absolútne vyššej spotreby krmiva, resp. jeho živín a energie, o čom svedčia štatisticky významné rozdiely priemerov pokusných skupín voči kontrole ($P < 0,05$). Zo súhrnu týchto výsledkov potom vyplýva, že vyššia úžitkovosť nosníc sa dosiahla pri nezmenenej účinnosti krmiva pri tvorbe vaječnej hmoty. Za činiteľov, ktorí stimulovali zvýšený príjem krmiva, považujeme kvali-

I. Metodická schéma pokusov – Methodical layout of trials

Skupina[1]	Podiel N-látok sóje v kŕmnej zmesi[2] (%)	Z toho N-látok vo forme[3]	
		sójového extrahovaného šrotu[4] (%)	extrudovanej plnotučnej sóje[5] (%)
Pokus[6] č. 1 – nosnice[7] (n = 3 skupiny[8] x 8 podskupín[9] x 10 = 240 nosníc[7])			
I.	45	100	–
II.	52	75	25
III.	52	55	45
Pokus[6] č. 2 – brojlerové kurčatá[10] (n = 3 skupiny x 4 podskupiny x 50 = 600 kurčiat[10])			
I.	50	100	–
II.	55	67	33
III.	52	50	50

[1]group, [2]soya crude protein content in feed mixture, [3]out of this: in form of, [4]soybean meal, [5]extruded full-fat soya, [6]trial, [7]layers, [8]groups, [9]subgroups, [10]broiler chickens

II. Informatívna skladba a obsah živín v kŕmnych zmesiach – Informative composition and content of nutrients in feed mixtures

Suroviny[1]		Pokus[10] č. 1 – nosnice[21]			Pokus č. 2 – brojlerové kurčatá[22]		
		skupiny[23]					
		I	II	III	I	II	III
Zrnoviny[2*]		702	688	671	639/684/724	597/668/708	619/665/707**
Sójový extrahovaný šrot[3]		180	155	120	260/240/220	260/140/140	130/120/110
Extrudovaná plnotučná sója[4]		–	50	110	– / – / –	60/120/100	150/140/128
Krmivá živočíšneho pôvodu[5]		25	10	–	85/60/40	55/50/35	85/60/40
Minerálne krmivá[6]		88	92	94	11/11/11	23/17/12	11/10/10
Vitamíny[7]		5	5	5	5/5/5	5/5/5	5/5/5
Spolu[8]	kg	1 000	1 000	1 000	1 000/1 000/1 000	1 000/1 000/1 000	1 000/1 000/1 000
Obsah v 1 kg[9]:							
N-látky[10]	g	172	172	173	220/200/181	220/199/181	220/200/181
ME_N	MJ	11,6	11,6	11,6	12,1/12,3/12,4	12,1/12,7/12,8	12,8/12,9/13,0
Metionín[11]	g	3,3	3,2	3,2	5,3/4,9/4,0	5,4/4,9/4,0	5,4/4,9/4,0
Metionín + cystín[12]	g	5,6	5,7	5,6	9,3/8,8/7,8	9,4/8,8/7,8	9,3/8,7/7,7
Lyzín[13]	g	7,5	7,5	7,6	11,6/10,1/8,5	12,3/10,6/8,6	11,6/10,2/8,6
Treonín[14]	g	5,8	5,8	5,9	8,2/7,4/6,5	8,5/7,6/6,5	8,2/7,4/6,5
Tryptofan[15]	g	1,8	1,9	1,9	2,4/2,2/1,9	2,6/2,3/1,9	2,4/2,2/1,9
Kys. linolová[16] C 18:2	relat.	100	130	130	100/100/100	150/160/150	190/175/165
Vápnik[17]	g	34,1	34,2	34,0	10,1/8,0/7,6	10,1/8,0/7,5	103/8,0/7,4
Fosfor nefytátový[18]	g	3,1	3,0	3,0	4,9/3,9/3,4	5,0/4,0/3,4	5,1/4,1/3,5
* z toho kukurica[19]	%	57	52	52	83	86	82

** údaje sú v poradí: predvýkrmová – výkrmová – dokrmová zmes – data sequence: starter – grower – finisher

[1]ingredients, [2]grains, [3]soybean meal, [4]extruded full-fat soya, [5]feeds of animal origin, [6]mineral feeds, [7]vitamins, [8]total, [9]content per 1 kg: [10]crude protein, [11]methionine, [12]methionine + cystine, [13]lysine, [14]threonine, [15]tryptophan, [16]linoleic acid, [17]calcium, [18]nonphytate phosphorus, [19]out of this: corn %, [20]trial, [21]layers, [22]broiler chickens, [23]groups

III. Obsah základných živín v kg v plnotučnej extrudovanej sóje – The content of basic nutrients in kg of full-fat extruded soya

Ukazovateľ	g
Sušina[1]	940
N-látky[2]	393
Tuk[3]	165
Vláknina[4]	40
Popol[5]	52
Metabolizovateľná energia (orientačne výpočtom)[6] MJ	13,9

[1]dry matter, [2]crude protein, [3]fat, [4]fiber, [5]ash, [6]metabolizable energy (orientation calculation)

tatívne vlastnosti plnotučnej sóje, resp. jej tuku, ako aj fyzikálno-štruktúrne, príp. subjektívno-chuťové vlastnosti krmiva ako takého.

Pokusné zásahy neovplyvnili základné technologické vlastnosti vajca (pomer vnútorných častí, kvalita bielka), ale pozitívne pôsobili na zložky žĺtkového tuku (tab. V). Komplexom pokusných zásahov (vrátane prítomnosti plnotučnej sóje v krmive a vylúčenia krmív živočíšneho pôvodu zo skladby kŕmnej zmesi v skupine III) sa obsah cholesterolu štatisticky vysoko významne ($P < 0,01$) znížil z 11,3 v kontrole na 10,7, resp. 10,1 mg/g žĺtka v pokusných skupinách. V celom vajci konzumnej veľkosti zodpovedá zníženie hodnote

IV. Výsledky pokusu č. 1 – znáška sliepok – The results of trial no. 1 – layer production

Skupina[1]	Znáška vajec (ks/nosnica)[2]	Hmotnosť vajca[3] (g)	Vaječná hmota (kg/nosnica)[4]	Spotreba krmiva[5]	
				na kus a deň[6] (g)	na kg vaječnej hmoty[7] (kg)
I.	274,9[a]	60,3[a]	16,58[a]	117,1[a]	2,29[a]
II.	279,4[a]	60,8[a]	16,97[a]	121,0[b]	2,31[a]
III.	282,8[b]	61,6[b]	17,41[b]	122,9[b]	2,29[a]

$P < 0,05$

[1]group, [2]egg production (eggs per layer), [3]egg weight, [4]egg mass (kg/layer), [5]feed consumption, [6]per layer/day, [7]per kg of egg mass

V. Fyzikálno-chemické ukazovatele kvality vajec v pokuse č. 1 – Physico-chemical indicators of egg quality in trial no. 1

Skupina[1]	Podiel[2] (%)		Haughove jednotky bielka[5] (HU)	Farba žĺtka[6] (ROCHE)	Obsah cholesterolu[7]	
	žĺtka[3]	bielka[4]			žĺtok[3] (mg/g)	vajce[8] (mg)
I.	26,8	62,1	74,9	$12,5^{a}$	$11,3^{Aa}$	211^{Aa}
II.	26,8	62,0	74,5	$12,8^{a}$	$10,7^{Ab}$	201^{Ab}
III.	27,2	61,6	74,0	$13,1^{b}$	$10,1^{Bb}$	194^{Bb}

$^{a}P < 0,05$, $^{A}P < 0,01$

[1]group, [2]content of, [3]yolk, [4]albumen, [5]albumen Haugh units, [6]yolk color, [7]cholesterol content, [8]egg

VI. Výsledky pokusu č. 2 – výkrmnosť a jatočná hodnota brojlerov – The results of trial no. 2 – fattening performance and carcass value of broilers

Skupina[1]	Živá hmotnosť[2] vek (dni)[3]		Konverzia krmiva[4] 1 :	Úhyn[5] (%)	Jatočná hodnota[6]		
	21	42			podiel trupu[7] (%)	výťažnosť[8] (%)	abdominálny tuk[9] (%)
I.	644^{a}	$1\,945^{a}$	$1,839^{a}$	8,0	$64,9^{a}$	$73,5^{a}$	$2,2^{a}$
II.	666^{a}	$2\,049^{b}$	$1,792^{a}$	4,4	$66,2^{a}$	$74,9^{a}$	$2,3^{a}$
III.	717^{b}	$2\,072^{b}$	$1,777^{a}$	2,5	$66,2^{a}$	$75,2^{a}$	$3,1^{b}$

$P < 0,05$

[1]group, [2]live weight, [3]age (days), [4]feed conversion, [5]mortality, [6]carcass value, [7]carcass percentage, [8]dressing percentage, [9]abdominal fat percentage

asi 10 %, čo z hľadiska dieteticko-zdravotných trendov v humánnej výžive možno hodnotiť pozitívne. Na subjektívno-kvalitatívne vlastnosti vajce pôsobili pokusné zásahy priaznivo aj tým, že sa zvýšila intenzita žltej pigmentácie vaječného žĺtka ($P < 0,05$), čo súvisí s lipofilným charakterom pigmentujúcich oxikaroteínov a ich vyššou rozpustnosťou v prítomnom sójovom oleji v krmive.

Pokusné zásahy (tab. VI) štatisticky významne ($P < 0,05$) zvýšili jatočnú hmotnosť brojlerových kurčiat v oboch variantoch (t.j. v skupinách II a III) pri odlišnom účinku týchto zásahov vo vekovej závislosti (t.j. do veku 21 dní). V zúžitkovaní krmiva na tvorbu prírastku vznikli iba numerické rozdiely medzi kontrolnou skupinou a pokusnými skupinami (2,6 až 3,4 %) s trendom, ktorý bol súhlasný so zvyšovaním energetickej hodnoty krmiva. Zo zovšeobecnenia vzťahu spotreby krmiva, N-látok a energie voči vytvorenému prírastku tela vyplýva, že zvýšením príjmu energie u kurčiat pokusných skupín o 1 % sa znížila spotreba N-látok (resp. zvýšilo sa ich zužitkovanie v tele) o 0,5 %. Toto zistenie je v plnom súlade s poznatkami o pozitívnom vplyve energie na účinnosť živín pri raste mladého organizmu.

Pri numerickom zvýšení jatočnej výťažnosti kurčiat sa štatisticky významne ($P < 0,05$) zvýšil podiel abdominálneho tuku na hmotnosti trupu pri intenzívnejšej variante pokusného zásahu (t.j. v skupine III). Tento efekt nielen s najväčšou pravdepodobnosťou súvisí s vyššou úrovňou energetickej výživy, ale vyplýva aj zo známeho vzťahu medzi vysokou rastovou schopnosťou a súčasnou nevyhnutnou tvorbou tuku v tele moderných výkrmových hybridov brojlerov (K i e l a n o w s k i, 1972).

Z prepočtu tvorby N-látok a vnútrosvalového tuku (tab. VII) vyplýva, že súborom pokusných zásahov sa v tele pokusných kurčiat zvýšila produkcia bielkovín v stehnovom a prsnom svalstve o 7 až 8 % a tuku o 3 %. To prakticky znamená, že konzument by v celom tele kurčaťa dostal navyše absolútne 10 g svalovej bielkoviny spolu s 0,3 g vnútrosvalového tuku.

Kvalitatívny účinok pokusného zásahu sa podľa tab. VIII prejavil aj zmenami v sekvencii mastných kyselín v tuku kurčiat. Pritom zvýšenie podielu kyseliny linolovej C 18:2 pri súčasnom poklese podielu kyseliny olejovej C 18:1 (pri zmene pomeru polynenasýtených mastných kyselín k nasýteným mastným kyselinám PUFA : SFA z 0,55 na 1,1) má pozitívny význam z hľadiska zdravotno-dietetických kritérií konzumenta potravín živočíšneho pôvodu.

Údaje o vplyve skladovania tuku kontrolných a pokusných kurčiat na jeho kvalitu dokazujú síce dobrú stabilitu počas hlbokého zmrazenia, ale súčasne aj vysokú náchylnosť tuku zmenenej skladby u kurčiat pokusnej skupiny na oxidatívnu degradáciu pri extrémnom nedodržaní skladovacích teplôt ($P < 0,05$).

Z ekonomického zhodnotenia výsledkov pokusov vyplynulo, že za súčasných relácií cien sójového extrahovaného šrotu a plnotučnej extrudovanej sóje bolo použitie plnotučnej sóje jednoznačne výhodnejšie vo výkrme kurčiat ako u nosníc, pričom vyššie podiely takto spracovanej sóje v kŕmnych zmesiach umožnili aj vyššiu ziskovosť u nosníc i kurčiat ako podiely nižšie.

VII. Produkcia N-látok a tuku vo svalstve brojlerových kurčiat v pokuse č. 2 – Crude protein and fat production in the muscles of broiler chickens in trial no. 2

Skupina[1]	Hmotnosť svalstva[2] (g)			Produkcia[6] (g)		a^{***}
	prsné[3]	stehnové[4]	celkom[5]	N-látky[7*]	tuk[8**]	
I.	246	297	543	118	9,4	0,165
II.	264	319	583	127	9,4	0,170
III.	268	322	590	128	9,7	0,170

* pri priemernom obsahu 217 g N-látok/kg celého svalstva vo všetkých skupinách – with average content of 217 g crude protein/kg of total muscles in all groups

** pri obsahu 1,73 – 1,61 – 1,64 tuku/kg celého svalstva v jednotlivých skupinách – with contents of 1.73 – 1.61 – 1.64 g of fat per kg of total muscles in the respective groups

*** pomer N-látok prijatých krmivom a vytvorených v prsnom a stehnovom svalstve kurčiat – ratio of dietary crude protein to crude protein produced in breast and shank muscles of chickens

[1]group, [2]weight of, [3]breast muscle, [4]shank muscle, [5]total, [6]production of, [7]crude protein, [8]fat

VIII. Podiel mastných kyselín a kvalita tuku kurčiat v pokuse č. 2 – Fatty acid percentage and fat quality in chickens in trial no. 2

Ukazovatele tuku[1]	Skupina[18]	
	I.	II.
Mastné kyseliny abdominálneho tuku[2] (%):		
C 14:0 (myristová[3])	0,91	0,50
C 15:0 (pentadekanová[4])	0,29	–
C 16:0 (palmitová[5])	23,43	22,35
C 16:1 (palmitolejová[6])	8,30	5,26
C 18:0 (stearová[7])	6,01	5,52
C 18:1 (olejová[8])	44,12	35,09
C 18:2 (linolová[9])	15,72	28,52
C 18:3 (linolenová[10])	1,15	2,46
Pomer polynenasýtených a nasýtených mastných kyselín[11] (PUFA : SFA)	0,55	1,11
Náchylnosť na oxidatívne zmeny – peroxidové číslo[12]:		
– čerstvý tuk[13]	8^a	11^a
– po hlbokom zmrazení[14] (–20 °C – 30 dní[15])	42^a	38^a
– po 15 dňoch pri 20 °C[16]	719^a	$1\,613^b$
– po 29 dňoch pri 20 °C[17]	$1\,132^a$	$1\,473^b$

$P < 0,05$

[1]fat indicators, [2]fatty acids of abdominal fat, [3]myristic, [4]pentadecanoic, [5]palmitic, [6]palmitoleic, [7]stearic, [8]oleic, [9]linoleic, [10]linolenic, [11]poly-unsaturated to saturated fatty acids ratio, [12]inclination to oxidative changes - peroxide value, [13]fresh fat, [14]after deep freezing, [15](–20 °C – 30 days), [16]after 15 days at 20 °C, [17]after 29 days at 20 °C, [18]group

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THE EFFECT OF THERMAL PROCESSING OF FABA BEANS, PEAS AND SHELLED GRAINS ON THE RESULTS OF RAISING TURKEYS

VLIV TEPELNÉHO ZPRACOVÁNÍ BOBU OBECNÉHO, HRACHU A LOUPANÝCH ZRNIN NA VÝSLEDKY ODCHOVU KRŮŤAT

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ABSTRACT: Studies were carried out on 840 unsexed turkey poults WAMA-1 randomly divided into 7 feeding groups, 120 birds in each group. The birds were reared in cages with litter, until 16 weeks of age in the case of females and 24 weeks in the case of males. 8–10% of soybean meal in the experimental feed mixtures were replaced with 16–17% of faba bean meal (var. Nadwiślański) or 20–24% of peas (var. Aster). Faba beans and peas were administered raw or after 30 min hydrothermal treatment at 120 °C and the pressure of 1 atm. Ground oats and shelled barley meal at the amount of 10–15% were used instead of maize meal, or unshelled barley at the amount of 20–40%, but leaving also the shelled oats. Dry feed mixtures of the percentage composition and their nutritive value were given *ad libitum*. The following parameters were periodically controlled during turkey rearing: body weight, feed intake, bird survival, digestibility of feed components, dressing percentage and meat quality. In the case of faba bean and pea seeds, analyses were also done of their amino acid composition and anti-tripsin activity. The results of rearing showed that it was possible to supply the diet for growing turkeys with 16–17% of faba bean or 20–24% of pea, partly replacing soybean meal, and to use barley (20–40%) and oats (10–15%) in place of maize. These substitutes did not decrease the effects of production, nor the dressing percentage and meat quality of turkeys. There was no noticeable effect of faba bean and pea steaming on the results of turkey rearing.

turkeys; fattening; faba bean; pea

ABSTRAKT: Pozorování jsme uskutečnili na 840 nesexovaných krůtatech typu WAMA-1, která jsme rozdělili do sedmi pokusných skupin po 120 krůtatech. Odchov krůťat probíhal v klecích s podestýlkou, u krůt do věku 16 týdnů a u krocanů do věku 24 týdnů. 8 až 10 % sójového extrahovaného šrotu v pokusných krmných směsích jsme nahradili 16 až 17 % bobového šrotu (bob odrůdy Nadwiślański) nebo 20 až 24 % hrachu (odrůda Aster). Bob obecný a hrách se zkrmovaly buď v surovém stavu, nebo po 30minutovém hydrotermickém zpracování při teplotě 120 °C a tlaku 1 atm. Místo kukuřičného šrotu jsme použili mletý oves a šrot z loupaného ječmene v množství 10 až 15 %, nebo neloupaný ječmen v množství 20 až 40 %, přičemž loupaný oves jsme nenahradili. Suché krmné směsi, jejichž procentuální složení a nutriční hodnoty jsou uvedeny v tab. I a II, jsme podávali *ad libitum*. Během odchovu krůťat jsme pravidelně sledovali tělesnou hmotnost, příjem krmiva, přežívání krůťat, stravitelnost jednotlivých složek krmiva, jatečnou výtěžnost a kvalitu masa. U bobu obecného a u hrachu jsme analyzovali složení jejich aminokyselin a stanovili jsme antitrypsinovou aktivitu. Rozdíly v nutriční hodnotě bílkovin bobu obecného a hrachu se týkaly hlavně obsahu metioninu a lyzinu. Hrách měl vyšší obsah obou aminokyselin (tab. III). Napařování snížilo antitrypsinovou aktivitu u bobu obecného o 32,8 % a u hrachu o 31,5 %. Použití bobového a hrachového šrotu (které nahradily sójový šrot), jakož i loupaného ječmene a ovsa (jako náhrada kukuřice), neovlivnilo stravitelnost živin ani retenci dusíku (tab. IV). Napařování hrachu a bobu obecného podle očekávání zvýšilo stravitelnost vlákniny o 9,8 až 57,8 %. Zvýšení obsahu neloupaného ječmene na 20 až 40 % vedlo k mírnému snížení stravitelnosti některých živin a retence dusíku (tab. IV). Ukázalo se, že za 16 týdnů byla tělesná hmotnost krůt pokusné skupiny vyšší o 0,8 až 8,8 % a za 24 týdnů o 3,7 až 8,4 % (tab. V). Příjem krmiva na jednotku hmotnostního přírůstku se v prvních 16 týdnech odchovu krůt pohyboval od 2,9 do 3,08 kg, zatímco příjem bílkovin činil 0,54 až 0,59 kg (tab. VI). Pro období odchovu v délce 24 týdnů činily tyto hodnoty 3,58 až 3,93 kg a 0,63 až 0,71 kg. Získané výsledky nenaznačují nepříznivý vliv pokusných krmiv. Jatečné rozbory nepřinesly významné rozdíly mezi skupinami, pokud se jedná o jatečnou výtěžnost (78,3 až 80,6 % u 16týdenních krůťat a 80,8 až 82,4 % u 24týdenních krůt) a o části jatečného trupu (tab. VIII). Výsledky chemického složení a fyzikálně-chemických rozborů prsní svaloviny naznačily, že výkrm krůt pokusnými krmnými dávkami neměl

za následek snížení kvality masa. Výsledky odchovu opravňují k předpokladu, že do krmné dávky pro rostoucí krůty je možné zařadit 16 až 17 % bobu obecného nebo 20 až 24 % hrachu a částečně tak nahradit sójový šrot, a dále, že místo kukuřice lze použít ječmen (20 až 40 %) a oves (10 až 15 %). Tato náhrada nesnížila výsledky produkce, jatečnou výtěžnost ani kvalitu krůtího masa. Nezaznamenali jsme výrazné účinky napařování bobu obecného a hrachu na výsledky odchovu krůt.

krůty; výkrm; bob obecný; hrách

INTRODUCTION

It has been known for a long time that the resources of plant feed protein can be increased by developing the cultivation of pulse crops for seed. In the majority of research on poultry it has been shown that it is possible to use faba bean seeds in the amounts varying from 20 to 45% (Mazanowski et al., 1983; Mikulski et al., 1995; Smulikowska, Chibowska, 1993), or peas from 20 to 55% (Kołodziej, 1989; Koreleski et al., 1987; Vancev et al., 1987). The authors particularly emphasize the importance of increasing the energy value and content of methionine and lysine in the mixtures containing large amounts of faba beans or peas (Eggum, 1980; Sarif, 1987; Smulikowska, Chibowska, 1993; Vancev et al., 1987).

A common feature of pulse crops is that they contain substances which inhibit utilization of nutrients and compounds, causing imbalance of the organism homeostasis, which, in turn, may affect bird health and capacity (Rubio, Brenes, 1988; Rubio et al., 1990).

A survey of the literature shows that a processing of pulse seeds may have a positive effect on their nutritional value due to the lowering of the inhibitor and toxin activity, and an increase in the assimilability of some nutrients. The majority of research concerns thermal processing, which seams to be the easiest method (Ernest, 1984; Ilian et al., 1985; Koreleski, 1987). There is still an interest in the possibility of using local grains instead of maize in the feed mixtures for poultry (Küskinen, 1986; Rutkowski et al., 1986; Tsvetanov, 1988).

Hence, the objective of this study was to establish the effect of feeding mixtures containing ground meal from steamed faba beans and peas to young slaughter turkeys instead of a part of soybean meal, and hulled barley and oats instead of maize. Estimates were based on the results of raising birds as well as on the yield and quality of slaughter material.

MATERIAL AND METHODS

This experiment was carried out at a poultry farm at the Department of Poultry Science, University of Agriculture and Technology in Olsztyn, Poland.

The research material consisted of 840 unsexed young, white wide-breast turkeys, the WAMA-1 hybrids (J-134), placed randomly in 7 groups of 120 birds each, in three repetitions (3 x 40 birds). Raising was conducted for 16 and 24 weeks for female and male turkeys, respectively, in cages with bedding, according to the zootechnical requirements.

In experimental feeds (Tab. I) 8 to 10% of soybean meal was replaced by 16 to 17% faba bean meal (*Vicia faba* L. var. Nadwiślański – groups II–IV) or 20 to 24% peas (*Pisum sativum* L. var. Aster – groups V–VII). Faba beans (groups II, III) and peas (groups V, VI) were first processed hydrothermally at 120 °C and 1 atm. of pressure for 30 minutes. For the turkeys from groups IV and VII, faba beans and peas were administered in the form of raw ground meal.

Instead of maize meal, hulled barley and oats were used at 10–15% each, or unshelled barley at 20 to 40% mixed with shelled oats (groups III, IV, VI and VII). Percentage composition of the feed mixtures is presented in Tab. I. Feeding periods for specific feeds and their nutritional values are shown in Tab. II. Dry feed mixtures were fed to turkeys *ad libitum* (starter – till 4 weeks of age; grower – from 5th to 10th week; finisher – from 11th weeks of age). Amino acid composition of faba bean and pea seeds was established using a JLC-6 AH automatic analyser (by Jeol), and antitrypsin activity using the method of Kakade et al. (1974).

The digestibility of nutrients was determined by the balance method during the feeding of particular feeds, i.e. in week 4, 10 and 15 of breeding, on three males each time. Faeces were collected for 5 days. Chemical analyses were done by the Wenden method, on the samples of feeds and skin-dried urine faeces at 50 °C. Separation of faeces nitrogen from urine nitrogen was done using the method of Ekman et al. (1949). The energy value of the feeds was formulated according to Nutrient Requirements of Poultry (1993).

Deaths and health disorders and their causes were controlled during bird breeding. Body weight was controlled periodically and feed intake in bird groups every seven days. Carcass analyses and dissection were conducted in the 16th week on the samples of ten birds (5 males and 5 females) from each group, and on ten males from the 24-week-old group.

Breast muscle samples were analysed for dry matter, crude protein, ether extract and ash, according to the official methods of the A.O.A.C. (1980). The physico-chemical properties of breast muscles were determined as follows: water absorbability (Grau, Hamm, 1953); lightness of colour (Kortz et al., 1968) and pH_{24} was determined in 24 hrs after slaughter, by pH-

I. Formulation of experimental diets (%)

Ingredients	Feeding group – Type of mixture														
	I			II			III–IV			V			VI–VII		
	S	G	F	S	G	F	S	G	F	S	G	F	S	G	F
Maize	30.0	20.0	20.0	–	–	–	–	–	–	–	–	–	–	–	–
Wheat	28.0	29.0	35.0	21.0	27.5	33.0	16.0	12.5	14.5	16.0	24.5	33.0	11.0	4.0	8.0
Barley	–	8.0	15.0	–	5.0	11.5	20.0	30.0	40.0	–	–	5.0	20.0	30.0	40.0
Hulled barley	–	–	–	15.0	10.0	10.0	–	–	–	15.0	10.0	10.0	–	–	–
Hulled oats	–	–	–	15.0	10.0	10.0	15.0	10.0	10.0	15.0	10.0	10.0	15.0	10.0	10.0
Faba bean meal	–	–	–	16.0	16.0	17.0	16.0	16.0	17.0	–	–	–	–	–	–
Pea meal	–	–	–	–	–	–	–	–	–	20.0	24.0	23.0	20.0	24.0	23.0
Soybean meal (42,0%)	21.0	18.0	8.0	11.0	9.0	–	11.0	9.0	–	11.0	9.0	–	11.0	9.0	–
Fodder fat concentrate (50%)	–	7.0	10.0	–	5.0	10.0	–	5.0	10.0	–	5.0	10.0	–	5.0	10.0
Fish meal	4.0	5.0	–	4.0	5.0	–	4.0	5.0	–	5.0	5.0	–	5.0	5.0	–
Meat-bone meal	3.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Blood meal	8.0	–	–	7.0	–	–	7.0	–	–	7.0	–	–	7.0	–	–
Fodder yeast	2.0	5.5	4.5	2.0	5.0	1.0	2.0	5.0	1.0	2.0	5.0	1.5	2.0	5.5	1.5
Limestone	0.6	0.5	0.7	0.6	0.5	0.7	0.6	0.5	0.7	0.6	0.5	0.7	0.6	0.5	0.7
Dicalcium phosphate	1.8	0.5	0.5	1.8	0.5	0.5	1.8	0.5	0.5	1.8	0.5	0.5	1.8	0.5	0.5
Salt (NaCl)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Premix IB*)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
DL-methionine (40% premix)	0.3	0.2	–	0.3	0.2	–	0.3	0.2	–	0.3	0.2	–	0.3	0.2	–
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

S – starter, G – grower, F – finisher

Feeding periods (age, weeks): starter – from 1 to 4, grower from 5 to 10, finisher from 11 to end

*) Premix supplied the following per kilogram of diet: retinyl propionate – 10 000 IU, cholecalciferol – 2 000 IU, alpha tocopherol acetate – 5 IU, vitamin K – 2 mg, vitamin B_{12} – 1 mg, riboflavin – 7 mg, Ca pantothenate – 15 mg, niacin – 60 mg, folic acid – 0,5 mg, pyridoxine – 1,5 mg; bacitracin – 25 mg; ethoxyquin – 125 mg, $FeSO_4 . 7 H_2O$ – 150 mg, $MgSo_4 . 7 H_2O$ – 3 mg, $MnCO_3$ – 90 mg, ZnO – 75 mg, $CuSO_4 . 5 H_2O$ – 15 mg, KIO_3 – 1 mg

II. Nutrient content of experimental diets

Specification	Type of mixture	Feeding group						
		I	II	III	IV	V	VI	VII
		g/100 g of feed						
Crude protein	starter	26.8	28.0	28.0	27.7	26.6	26.0	26.0
	grower	23.1	22.8	21.5	22.2	22.6	22.9	23.0
	finisher	15.4	15.4	14.8	14.8	15.1	14.8	15.7
Crude fibre	starter	3.9	4.0	3.6	4.0	3.6	4.1	3.2
	grower	3.5	4.1	4.4	4.6	4.1	4.3	4.0
	finisher	5.3	5.2	4.5	4.9	5.4	4.9	5.2
Crude fat	starter	2.7	1.9	2.6	2.2	2.2	2.6	2.7
	grower	6.2	4.7	4.9	5.2	4.2	5.2	5.2
	finisher	8.1	6.7	6.5	6.6	7.2	6.6	7.0
Apparent metabolizable energy (AME_N)*) (MJ/kg of feed)	starter	11.5	11.4	11.1	11.0	11.5	11.4	11.1
	grower	12.2	12.0	11.7	11.7	12.2	12.0	11.7
	finisher	13.0	12.9	12.7	12.6	13.1	12.9	12.7

*) Values calculated according to Nutrient Requirements of Poultry (1993)

-meter electrodes (Radiometer glass GK 2311c). The rearing efficiency index (REI) of turkeys up to 16 weeks of age was calculated from the formula:

$$REI = \frac{a \cdot b}{10 \cdot c}$$

where: a – daily weight gain (g/bird)
b – bird survival (%)
c – feed intake (kg/kg of weight gain)

Data obtained were statistically processed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The differences in faba bean (65.8) and pea (68.1) protein nutritional value concerned mainly the contents of methionine and lysine. Peas contained more of both (Tab. III). Similar results were obtained by Koreleski et al. (1987) and Vancev et al. (1987).

Steam treatment caused only a small decline of the EAA-index in faba bean seeds (0.5–0.6%), and about 1.7% in peas. The highest antitrypsin activity was observed in soybean meal (6 700 TUI/g of sample). Raw faba bean seeds (Nadwiślański variety) contained 5 800, and peas (Aster variety) 5 400 trypsin inhibitor activity units. In a study by Ernest (1984), the autoclaved soya contained from 2 175 to 6 985 TUI/g of the sample, and raw faba bean seeds (Major variety) were at 2 628 TUI/g.

Antitrypsin activity in peas (Hamill variety) was determined by Pisulewski et al. (1983) at 2 567 TUI/g. Valdebouze et al. (cit. Ernest, 1984) suggested that large differences in the content of the trypsin inhibitor occurring in pulse crops depend on genetic and environmental factors. Our work confirmed the observations of Belitz et al. (cit. Ernest, 1984) on slightly higher antitrypsin activity in faba beans than peas.

III. Chemical composition (% DM) and amino acid content (g/16 g N) of faba bean and pea seeds

Ingredients	Faba bean		Pea	
	raw	autoclaved	raw	autoclaved
Crude protein	28.82	29.99	22.84	25.74
Crude fibre	8.13	6.56	4.67	4.69
Crude fat	2.28	2.18	2.86	2.82
Crude ash	3.59	3.52	3.12	3.28
N-free extracts	57.18	57.75	66.51	63.47
Lysine	6.29	6.14	7.93	7.40
Methionine	0.88	0.91	1.30	1.29
Cystine	1.31	1.30	1.34	1.26
Threonine	3.54	3.46	3.52	3.52
Histidine	2.58	2.53	2.67	2.26
Isoleucine	4.03	4.00	4.06	3.88
Leucine	7.76	7.67	7.30	7.06
Phenylalanine	4.04	4.07	4.41	4.31
Tyrosine	3.31	3.12	3.05	2.95
Valine	4.50	4.50	4.58	4.46
EAA Index	65.8	65.3	68.1	66.4

Steam treatment decreased antitrypsin activity of faba bean seeds by 32.8% (3 900 TUI/g), and that of peas by 31.5% (3 700 TUI/g). In the research of Ernest (1984) thermal processing of faba beans decreased the activity of trypsin inhibitor by a higher factor – 45.8%, and according to Ilian et al. (1985) – even by 53–62%.

Changes in mixture composition consisting in replacement of imported feeds by domestic feeds did not cause any significant differences in fatty acid composition (from

IV. Coefficients of apparent digestibility and N retention (%)

Specification	Type of mixture	Feeding group						
		I	II	III	IV	V	VI	VII
		g/100 g of feed						
Crude protein	starter	88.4	89.0	86.3	84.1	87.8	85.4	84.1
	grower	89.3	87.6	84.1	85.9	88.6	84.4	86.2
	finisher	82.1	82.5	80.1	83.1	82.0	83.1	80.5
Crude fibre	starter	21.7	20.9	19.9	14.3	19.5	24.5	16.5
	grower	14.9	19.8	18.1	16.1	21.1	16.2	14.6
	finisher	24.3	24.2	23.5	21.4	20.9	17.2	10.9
Crude fat	starter	79.3	83.0	80.4	81.2	85.7	86.2	83.1
	grower	86.9	87.3	83.8	84.4	88.6	82.4	85.0
	finisher	88.6	87.9	85.8	82.1	87.7	83.0	88.2
N-free extracts	starter	77.8	78.6	74.4	78.5	77.2	76.8	74.5
	grower	69.8	76.7	73.0	76.1	75.4	79.0	73.5
	finisher	76.0	80.0	79.8	73.9	80.5	75.4	78.7
N-intake retention	starter	62.4	63.2	62.6	62.8	63.8	63.9	63.1
	grower	60.3	60.5	60.0	60.9	61.1	60.4	61.7
	finisher	53.7	54.9	52.2	53.1	52.4	55.1	52.4

14 to 20 C) in the fat of those fodders comparing to fat in control fodder (Mikulski et al., 1992).

An introduction of faba bean meal or steamed peas (instead of soybean meal), and barley with shelled oats (instead of maize) into the experimental feeds decreases the digestibility of nutrients and nitrogen retention (Tab. IV). No significant changes were observed in the digestibility of protein, fat and nitrogen-free extracts, nor in nitrogen retention due to the steaming process of faba bean and pea seeds; while the digestibility of crude fibre improved by 9.8–57.8%. Increasing the amount of shelled (instead of unshelled) barley to 40% resulted in a periodic decrease of nutrient digestibility and nitrogen retention. In other studies (Jamroz et al., 1980), an addition of faba bean meal did not decrease digestibility and nitrogen retention in chickens. On the other hand, Ernest (1987) stated that faba bean meal decreased the results of digestibility experiments. While in other studies Ernest (1984) noted an improvement in the digestibility of protein due to the steaming process.

Feeding the feeds containing faba bean or pea meals and maize substitutes to turkeys did not cause any (statistically significant) differentiation of the body weight (Tab. V). Yet, birds from the first (control) group gained weight better than those from the experimental groups up to 8 weeks and weighed 2 727 g on the average (100–230 g more, i.e. 3.8–8.5%). However, 16- and 24-week-old turkeys from the first group grew more slowly (6 588 and 12 682 g) than those in the experimental groups. Body weight of turkeys from the experimental groups turned out to be 0.8–8.8% higher after 16 weeks, and 3.7–8.4% higher after 24 weeks. Adding faba bean or pea meals and maize substitutes to the feeds did not decrease weight gains in turkeys.

V. Average body weight of turkeys (g)

Group	Statistics	Age (weeks)		
		8*)	16*)	24**)
I	$\bar{x}$	2 727[a]	6 588[a]	12 682
	n	118	110	55
	±SD	420	921	1 319
II	$\bar{x}$	2 585	6 821	13 400
	n	118	118	58
	±SD	348	954	775
III	$\bar{x}$	2 623	6 968	13 752
	n	116	112	53
	±SD	412	1 028	1 140
IV	$\bar{x}$	2 597	6 936	13 254
	n	116	116	58
	±SD	418	1068	1 226
V	$\bar{x}$	2 496[b]	7 166[b]	13 148
	n	112	108	52
	±SD	376	1 039	1 241
VI	$\bar{x}$	2 517	6 641	13 261
	n	114	114	53
	±SD	408	1 324	1 366
VII	$\bar{x}$	2 608	6 884	13 188
	n	114	112	54
	±SD	329	1 077	1 126

*) males and females, **) males only
Means followed by different letters are significantly different: a, b – $P < 0.05$

These results did not reveal any noticeable effect of seed processing (steaming faba beans and peas, shelled barley) on body weight gains in turkeys.

VI. Feed (a), crude protein (b) in g and metabolizable energy intake (c) in MJ per 1 kg of body weight gain of turkeys

Group	Rearing period (weeks)								
	0–8			0–16			0–24		
	a	b	c	a	b	c	a	b	c
I	2 075	495	23.15	3 076	586	34.11	3 698	669	41.22
II	2 165	518	23.80	2 964	561	32.29	3 890	714	44.33
III	2 182	499	24.05	3 085	558	33.40	3 928	680	44.05
IV	2 329	540	25.05	3 054	562	32.60	3 809	654	40.90
V	2 309	532	26.04	2 980	551	32.91	3 880	672	43.01
VI	2 112	531	25.47	2 903	543	32.03	3 583	627	39.68
VII	2 135	505	25.85	2 980	567	32.46	3 752	670	41.03

VII. Losses of turkeys in the period until the 24 weeks of age in % and rearing efficiency index (REI) in scores

Rearing period (weeks)	Specification	Feeding group						
		I	II	III	IV	V	VI	VII
0–8	mortality	–	–	–	1.7	3.3	1.7	1.7
	culling	1.7	1.7	3.3	1.7	3.3	3.3	3.3
	total	1.7	1.7	3.3	3.4	6.6	5.0	5.0
0–16	mortality	6.7	–	–	1.7	5.0	1.7	1.7
	culling	1.7	1.7	6.7	1.7	5.0	3.3	5.0
	total	8.4	1.7	6.7	3.4	10.0	5.0	6.7
0–24	mortality	6.7	–	1.7	1.7	5.0	3.3	1.7
	culling	1.7	1.7	8.3	1.7	6.7	5.0	6.7
	total	8.4	1.7	10.0	3.4	11.7	8.3	8.4
0–16	**REI**	**155**	**185**	**177**	**171**	**174**	**175**	**172**

Feed consumption per 1 kg of body weight gain (Tab. VI) during 16 weeks of raising was from 2.9 kg (group VI) to 3.08 kg (group III), and crude protein intake from 543 g (group VI) to 586 g (group I). Also during the 24 weeks of rearing, the best feed, crude protein and metabolizable energy consumption were observed in turkeys from group VI (3 583 g, 627 g, and 39.68 MJ, respectively).

The available literature does not contain any description of the effect of pulse crops on body weight gain, feed consumption, and utilization of nutrients in poultry. Many authors did not observe any negative effects of administration of feeds containing pulse seeds to chickens and turkeys (Ernest, 1987; Karunajewa, Bartlett, 1985; Koreleski et al., 1987; Mazanowski et al., 1983; Sarif, 1987; Smulikowska, Chibowska, 1993). In other research performed on chickens, a decrease of body weight gain and consumption of feeds containing pulse seed meal was observed (Mikulski et al., 1995; Rutkowski, Gawęcki, 1988; Vancev et al., 1987).

In the published papers, partial or complete substitution of maize meal by other grain meal in the feeds for slaughter chickens and turkeys did not usually cause any increase in feed consumption (Kołodziej, 1988; Świerczewska et al., 1987). According to Tsvetanov (1988), substituting 50% of maize meal by wheat meal did not affect the consumption level in chickens, but complete substitution of maize meal by wheat meal increased consumption by 11%.

During the first 16 weeks of raising, the highest mortality of turkeys (Tab. VII) was observed in control group I (6.7%), mainly due to enterocolitis. In groups II and III mortality did not occur, and in other groups mortality was low (1.7–5.0%). The main health problems were rickets and perosis, which could have been induced by the presence of leguminous seeds in the feeds.

Estimation of bird health during research proved to be positive because deaths and health problems were within the acceptable range of 1.7–11.7%. No relationship was observed between feeding the experimental feeds and turkey health. In many papers on the suitability of pulse use in feeding, there were no major health problems observed either (Ilian et al., 1985; Jamroz et al., 1980; Mikulski et al., 1995).

Rearing efficiency indices (REI – Tab. VII) were the lowest (155) in turkeys from group I that received the feeds containing soybean and maize meals. In the case of turkeys from the experimental groups the rearing efficiency indexes were higher, from 171 to 185.

VIII. Average results of slaughter analysis of turkeys in the 16th*) and 24th**) week of age (%)

Specification	Age (weeks)	Feeding group						
		I	II	III	IV	V	VI	VII
1. dressing percentage	16	78.5[a]	79.5	80.6[b]	78.3[a]	80.2	80.5[b]	79.3
	24	81.0	81.8	80.8	81.8	82.4	81.3	81.8
2. abdominal fat	16	0.48	0.28	0.52	0.28	0.49	0.57	0.48
	24	0.29	0.60	0.41	0.59	0.47	0.45	0.52
3. breast muscles	16	25.5	25.6	25.5	25.4	26.4	25.8	25.6
	24	27.1	28.3	27.5	28.5	29.2	29.0	28.2
– in this fillet	16	5.4	5.5	5.5	5.3	5.1	5.3	5.1
	24	5.0	4.9	5.1	5.2	5.0	5.2	4.6
4. femural muscles	16	14.2	14.4	14.0	13.4	14.1	13.2	13.9
	24	14.2	14.0	14.6	13.5	13.7	13.4	13.2
5. tibial muscles	16	10.1	10.5	10.3	10.7[a]	9.8[b]	9.8[b]	9.8[b]
	24	10.0	10.2	10.4	9.9	9.5	9.6	9.4
6. breast and leg muscles in total	16	49.8	50.5	49.8	49.5	50.3	48.8	49.3
	24	51.3	52.5	52.5	51.9	52.4	52.0	50.8

Values of traits 1–2 calculated in relation to body weight before slaughter
Values of traits 3–6 calculated in relation to eviscerated carcass
Means followed by different letters are significantly different: a, b – $P < 0.05$
*) males and females, **) males only

IX. Chemical and physico-chemical characteristics of breast muscles in turkeys at the age of 16 and 24 weeks

Specification	Age (weeks)	Feeding group						
		I	II	III	IV	V	VI	VII
Chemical composition (%):								
Crude protein	16	23.0	22.1	22.1	21.7	22.1	22.5	22.3
	24	24.0	24.0	24.1	23.8	24.1	24.4	24.3
Crude fat	16	2.99	1.58	2.53	1.85	2.06	3.21	3.55
	24	1.21	1.22	1.29	1.62	1.00	0.70	1.70
Ash	16	1.14	1.15	1.14	1.14	1.09	1.12	1.00
	24	1.18	1.16	1.15	1.21	1.15	1.16	1.15
Physico-chemical properties:								
Water holding capacity (cm^2)	16	9.8	9.8	9.3	10.7	11.8	10.1	10.1
	24	4.4	4.1	4.6	4.9[a]	4.4	3.5[b]	4.7
Lightness of colour (%)	16	32.4	32.7	32.5	40.4	40.6	40.0	32.7
	24	26.0	28.0	25.8	25.2	27.8	25.6	27.0
pH_{24}	16	5.2	5.2	5.1	5.2	5.0	5.0	5.0
	24	6.0[b]	6.0[A]	6.0[A]	6.0[b]	5.9[Aa]	6.1[Bc]	6.1[Bc]

Means followed by different letters are significantly different: A, B – $P < 0.01$; a, b – $P < 0.05$

Dressing percentage (Tab. VIII) of 16-week-old turkeys was from 78.3 to 80.6%. After 24 weeks of rearing, there were no significant differences in dressing percentage between the groups (80.8–82.4%). No differences were observed in carcass tissue content either which would indicate the effect of the experimental feeds. Breast muscle share in the carcasses was from 25.4 to 26.4% at the age of 16 weeks, and from 27.1 to 29.2% at the age of 24 weeks. Breast and leg muscle share altogether was 48.8–50.5% in 16-week-old and 50.8–52.5% in 24-week-old turkeys.

In most studies the dressing percentage did not decrease in chickens that received the feeds containing pulses either, on the other hand Rutkowski and Gawęcki (1988) observed a significant lowering of dressing percentage in chickens fed the feeds containing pea meal.

There were no significant differences in the contents of crude protein, fat and ash in breast muscles (Tab. IX). Analyses of the meat from 16-week-old turkeys showed clear acid reaction (pH 5.0–5.2), which caused a decrease of water absorption (9.3–11.8 cm^2)

and made the meat colour lighter (32–40%). In meat samples from 24-week-old turkeys, water loss decreased significantly (3.5–4.9 cm^2), and so did the colour shade (25.2–28.0%), possibly due to increased protein and lower water content in the muscles. Meat pH also increased (5.9–6.1).

The results of chemical composition and physico-chemical evaluation suggest that the administration of experimental feeds to the birds did not affect the meat quality.

No negative effects of the used feeds upon the results of hematological examination of the turkeys (Ht, Hb, RBC, WBC) and biochemical parameters – activity of AspAT, AlAT and AP and level of total protein, glucose, calcium, inorganic phosphorus, iron, cholesterol and uric acid were observed (Koncicki et al., 1990).

CONCLUSIONS

The results of the experiment showed that it was possible to supply the diet for growing turkeys with 16–17% of faba bean or 20–24% of pea, partly replacing soybean meal, and to use barley (20–40%) and oats (10–15%) in place of maize. These substitutes did not decrease the effects of production nor the dressing percentage and meat quality of turkeys.

The results make it possible to conclude that the processing of seeds intended to be used in feed mixtures (in the above-mentioned amounts), such as faba bean and pea seed steaming, and barley seed shelling, is not necessary. There was no noticeable effect of faba bean and pea steaming on the results of turkey rearing.

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OBSERVATIONS ON LIVESTOCK AND FEED RESOURCES OF RAWAL EXPERIMENTAL WATERSHED AREA, PAKISTAN

SLEDOVÁNÍ HOSPODÁŘSKÝCH ZVÍŘAT A ZDROJŮ KRMIV V OBLASTI EXPERIMENTÁLNÍHO POVODÍ RAWAL V PÁKISTÁNU

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ABSTRACT: Livestock production is an essential agricultural activity in Pakistan contributing about one fourth to agricultural gross domestic products. Despite the importance of livestock in agricultural production, it has been the subject of much less research than the crops. The information regarding livestock of Pothwar area is scanty. The present study was initiated to record the total number, health and feeding pattern of livestock of Rawal Experimental Watershed Area. Major constraints in livestock production of the area are poor nutrition due to overgrazing, lack of range management, and animal mortality due to disease and parasite problems. The present study is of basic nature. This would not only help in the identification of local problems and resources but also would assist in the better management of our resources and future planning of our farming system.

livestock; production constraints; animal health; feed resources; over-grazing; soil erosion

ABSTRAKT: Živočišná výroba je v Pákistánu základní zemědělská činnost – k zemědělské hrubé domácí produkci přispívá asi z jedné čtvrtiny. Přes významnou úlohu, kterou hospodářská zvířata mají v zemědělské výrobě, byl jejich chov předmětem výzkumu v mnohem menší míře než pěstování plodin. Informace o hospodářských zvířatech v oblasti Pothwar jsou vzácné. Tato studie se uskutečnila s cílem evidovat celkový počet, zdravotní stav a strukturu výživy hospodářských zvířat chovaných v oblasti experimentálního povodí Rawal. Hlavními omezeními živočišné výroby v dané oblasti je nedostatečná výživa, která vyplývá z přílišného spásání porostů, neexistence pastevního hospodářství a úhyny zvířat v důsledku chorob a výskytu parazitů. Tato studie patří k základním pracím a má pomoci nejen při identifikaci místních problémů a při vymezení zdrojů, ale má být nápomocná i lepšímu řízení našich zdrojů a budoucímu plánování naší soustavy hospodaření.

hospodářská zvířata; omezení výroby; zdravotní stav zvířat; zdroje krmiv; přílišné spásání; půdní eroze

Introduction

Livestock plays a vital role in the agri-based economy of Pakistan, contributing about one fourth to agricultural gross domestic products. Livestock is an important source of animal proteins for the population of Pakistan and provides draft power for land preparation and transport, and raw materials for leather, carpet and woolen industries. Despite the importance of livestock in agricultural production, it has been the subject of much less research than the crops. Due to lack of research in the feeding habits, livestock and poultry industries are faced with innumerable problems of production, breeding and animal health (Akhtar, 1986). Husnain (1983) described that livestock production in Pakistan depends mainly on the traditional feeding methods with occasional inputs of feed processed by obsolete methods. Ajmal (1982) studied the health problems of sheep in Pakistan and described that pastures available in the form of rangeland vegetation is far less than the requirement of the number of animals being maintained. Dawson (1987) examined the interaction of soil-pasture-animal component of mixed farming system of Pakistan and emphasized that by matching pasture growth with animal requirements, meat production can be increased on grass-legume pasture systems.

The information regarding livestock of Pothwar area is scanty and the only published report is that of Shah

et al. (1985). They described the status of livestock production and health in the district of Islamabad, but it does not cover the Rawal Experimental Watershed Area (REWA). The present study was initiated to record the total number, health and feeding pattern of livestock of Rawal Experimental Watershed Area.

Rawal Experimental Watershed Area is located between 33°42' North and 73°60' East at a height of about 600 to 640 meters (Khan, 1962). It is situated at a distance of about 20 kilometers from Islamabad off way on Rawalpindi-Murree highway and spreads over an area of 900 hectares. The area serves as a catchment for Rawal dam and consists of three small villages namely 'Dadaya', 'Malach' and 'Badham' surrounded by Punjab reserve forests, Shamlats and Capital Development Authority (C.D.A.) reserve forests.

The area is not managed properly and has resulted in an increase rate of siltation in the surrounding Rawal dam. Most of the animals as well as some migratory herds tend to graze in the area (Shah et al., 1985). The climate of the area is classified as sub-tropical sub-humid (Mohammad, 1989). Amin et al. (1980) and Shafiq, Nizami (1986) observed the ecology and vegetation of the area and found it belonging to *Acacia modesta* and *Dodonia viscosa* zone.

Materials and Methods

A detailed livestock survey of Rawal Experimental Watershed Area was carried out in November 1994. The area is representative of crops and range vegetation of Pothwar area. A proforma was prepared to observe the socio-economic condition of the villagers. Individual farmers were interviewed by a team comprising a livestock specialist, an economist and a range scientist. Informal interviews were conducted based on FSSP (1986) and IRRI (1986) methods, with a check list of guideline questions and minimal amount of writing in the farmer's presence. Thirty farmer families at 'Dadaya', 35 at 'Badham' and 12 at 'Malach' were interviewed about their livestock. Information was collected regarding the kind, number and health of livestock. The feeding pattern of the livestock and marketing facility were also explored.

Results and Discussion

It was observed that farmers of Rawal Experimental Watershed Area raised various kinds of small and big livestock. It included cows, buffaloes, sheep and goats. Only 22 donkeys were reported in the area. Among the 77 families, the number of cows (including bulls) and buffaloes was 111 and 68 heads respectively. The number of goats (429) was much greater than the number of sheep (203). The goat and sheep are source of meat and mutton. Goats are preferred by the farmers due to their fast breeding life cycle. As the goat meat is a dietary preference in the society and they do not need special care, the goats provide good source of revenue to the farmers (Mahmood, Rodriguez, 1993; Rodriguez, 1994). Both goat and sheep act as reserve income for the farmers who sell them in the local market whenever they need money (Nagy et al., 1991; Mahmood, Rodriguez, 1993; Rodriguez, 1994). Buffaloes and cows are source of milk and other dairy products which are sold in the village as well as in the near market (Hanjra et al., 1987; Tulloh, 1991). Farmers have not yet adopted the mechanized means of agriculture. Moreover, holdings are very small. Therefore, bulls and cows are used for plowing in the fields and donkeys are used as draught animals.

The goats, cows and bulls graze on foothills, steep and gentle slopes, and sheep graze on plains. Buffaloes due to their heavy bodies cannot climb up the hills, therefore, farmers usually let them graze in the plains or provide them feed in the manner of stall feeding. Donkeys had to be contented on the left over feed of other livestock or appeased on whatever is available. It was observed that farmers were not following any systematic grazing pattern. The livestock graze on plains, foothills, gentle slopes, and steep slopes. This unmanaged grazing has created a problem of over-grazed vegetation and deteriorating range condition with unpalatable species dominating the area. Hence the available forage resources are quite inadequate resulting in the poor health and low livestock production in the area thereby hampering the rural economy (Shah et al. 1985; Akhtar, 1986). On the other hand erosion is very severe in the area and siltation rate in the Rawal dam is getting very high. It is suggested that grazing of the area be restricted and properly managed following some suitable grazing system (Mohammad, 1989; Quraishi et al., 1993; Thomas, Lascano, 1995). Likewise keeping proportion of sheep, goats and large ruminants within the carrying capacity can help in improving the range condition and livestock production. Moreover grazing should be completely stopped on foot hills, gentle and steep slopes, and seasons of use (e.g. deferred spring grazing) should be implemented.

Farmers should be encouraged to grow forage legumes and high yielding fodder shrubs along with their fields (Thomas, 1995; Thomas, Lascano, 1995). Inclusion of forage grasses and selected legumes in agropastoral systems of Latin America have been shown to markedly increase animal performance in terms of live weight gain, milk production and reproduction (Thomas, Lascano, 1995). Cultivation of a combination of forage grasses and selected legumes would provide nutritive fodder for the livestock and would increase soil fertility and will help control soil erosion. It is also recommended that suitable technology be developed to increase the fodder and forage production and to improve their nutritive value. Economical and efficient feeds and feeding practices should be developed utilizing crop residues and other crop by-products so that livestock does not remain un-

derfed (Mohammad, 1989; Quraishi et al., 1993; Thomas, Lascano, 1995). A high incidence of mortality and morbidity losses results from disease and parasitism. Many farmers indicated that various disease problems coincided with winter when feed was scarce. The farmers understand and appreciate the value of vaccination, de-worming and dipping. But veterinary services are limited or too expensive. Extension programs on a large scale are required to control disease and parasite problems. The present study is of basic nature. This would not only help in the identification of local resources but also would assist in the better management of our resources and future planning of our farming system.

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Upozornění pro autory vědeckých časopisů

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Redakce časopisu

FROM THE SPHERE OF SCIENCE

CURRENT PROBLEMS OF GENETICS, HEALTH, GROWTH AND PRODUCTION OF PIGS

The symposium was held (7 February, 1996) in České Budějovice, South Bohemia (Czech Republic) and was organized in cooperation between the Faculty of Agriculture of the University of South Bohemia (the departments of Special Animal Science, General Animal Science, Nutrition, and Anatomy and Physiology of Farm Animals), and the MR Servis, České Budějovice. Official languages were Czech, Slovak, English and German. Contributions were presented in main lectures and the different poster sessions (genetics, health, reproduction, breeding, nutrition, and economics). Some abstracts presented to the symposium are shown hereinafter. (Authors of the abstracts are responsible for their content.)

Prof. Ing. Václav Matoušek, CSc., doc. Ing. Bohuslav Čermák, CSc.
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THE EFFECT OF DIFFERENT BREED COMBINATIONS ON THE CONTENT OF INTRAMUSCULAR FAT OF FINAL HYBRIDS

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The content of intramuscular fat of different crossbreds was studied at a hybrid testing station. Samples of muscle tissue were taken from *musc. long. dorsi* 24 h *post mortem* and intramuscular fat was measured under laboratory conditions. The highest content of intramuscular fat $x = 3.94 \pm 0.308\%$ was found for the combination (BU x L) x (H x D), the lowest $x = 1.83 \pm 0.139\%$ for the combination (BU x L) x Pn. Optimum value of 2.5% in the literature was found to be higher for all studied combinations, except for Czech Meat pig (ČVM) and Pn in sire position, where the content of intramuscular fat < 2.5% was found. The negative correlations found in this study between parameters of carcass value and content of intramuscular fat indicate the need for including this parameter as a selection criterion for breeding pigs and hybrid combinations.

USE OF THE PATERNAL LINE 85 FOR THE PRODUCTION OD FINAL PIG HYBRIDS

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Regarding the need of an improvement of carcass value of final hybrids of pigs produced on Czech commercial farms, there are efforts to modify the programme of selection of the paternal pig population of the Czech Meat pig both by means of a rigorous selection within the framework of breeding pure and through an increase in the proportion of genes based on the immigration of genes of the Piètrain breed to produce the hybrid paternal line 85. In accordance with theoretical expectations, this combination gave positive results and the finished test demonstrated economic advantages of the use of this line for the production of final pig hybrids.

CORRELATIONS EXISTING AMONG TRAITS OF FEEDING CAPACITY AND CARCASS VALUE IN PIG POPULATIONS IN THE CZECH REPUBLIC

M. Čechová, S. Buchta

Mendel University of Agriculture and Forestry, Department of Pig Breeding, Brno, Czech Republic

Values of correlation coefficients of traits of feeding capacity and carcass value were calculated for purebred populations of maternal and paternal breeds. A very high correlation (0.95) was found between the weights of cold and warm right half-carcasses in all breeds under study. A high correlation was also found for the weight of ham (in kg) and the percentage of major meatcuts of the carcass.

THE INFLUENCE OF DAILY LIVE-WEIGHT GAIN OF LARGE WHITE X LANDRACE GILTS DURING REARING ON SELECTED REPRODUCTION TRAITS

J. Čeřovský, V. Hudeček

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The effect of the average daily weight gain was studied on 520 hybrid gilts up to 100 kg during their rearing period in relation to a) the age at the 1st mating, b) the average age on the day of the fertile insemination, c) the average age at the first farrowing and d) in relation to the production longevity. The results indicated that the best positive relationships were achieved in the group of the gilts with an average daily gain from 501 to 550 g.

THE POSSIBILITIES OF MOLECULAR GENETICS FOR PIG BREEDING

J. Dvořák

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In the first part, the application of genetic markers in breeding programmes for pigs was analyzed and was aimed at:

1) Combination of alleles from various breeds (MH)
2) Selection using the marker (MAS).

In the second part, genetic markers associated with commercially important properties (ETL) were described:

1) Meat quality – locus RYR and the gene influencing the content of intramuscular fat
2) Growth to a weight of 30 kg and of 70 kg – microsatellites on the 13th and 14th chromosomes
3) Fertility of sows – locus ESR and other potentially utilizable genes from the area of the hormonal control of oestrus and genes coding the growth factors, important for the embryonic development of piglets
4) Stress sensitivity – locus of the ryanodine receptor and candidate genes of stress or thermal shock (HSP)
5) Colour of piglets – genetic markers in a bonding group with the epistatic locus for colour.

Elaborated within the GAČR grant No. 1282.

CLOSTRIDIUM CAUSED PROBLEMS OF INFECTIOUS DISEASES OF PIGS

K. Hejlíček, A. Soukupová, J. Přikryl

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In so far as no systematic disinfection is guaranteed, in case of large-scale breeding and intensive production of piglets *Clostridium perfringens* bacteria can be largely extended in the stable and can be identified up to 50% of withdrawn smears or scrapings. Clostridium bacteria can excrete and spread in the environment up to 80% bred sows. As far as piglets are concerned, Clostridium bacteria cause whitish up to yellowish diarrhoea of a creamy consistence which can affect up to 90% litters in the birth hall. Dosage of Lactiferm probiotic (*Enterococcus faecium* M-74) to 13 sows, beginning three days before the supposed birth until the wean of piglets, caused that in case of 7 from originally 10 infected sows Clostridium bacteria in the droppings were eliminated or substantially reduced. Dosage of Lactiferm paste per os to piglets during the first days of their life halved the number of litters affected with diarrhoea and the loss-rate of piglets in the time from birth to the wean ranged about 10 to 12%.

EVALUATION OF ECONOMIC EFFICIENCY OF BREEDING HERDS OF LARGE WHITE BREED

L. Houška, J. Fiedler

Research Institute of Animal Production, Praha-Uhříněves, Czech republic

Data on 37 Czech White Improved breeding herds were evaluated. Large differences both in productivity level (litter size and litter weight at 21 days ranged from 8.1 to 10.6 piglets and from 41.2 to 60.9 kg, resp.) and amount of breeding animals produced (11.3–45.1% breeding gilts and 0.1–6.3% young breeding boars) were found. Results confirmed large differences in the selection intensity realized in individual breeding herds. High differences in rentability (18.8–57.7%) and the level of profit/sow/year (4 110–18 258 Czech crowns) can cause competition among the individual breeding herds and lead to imbalance of produced breeding animals.

THE INFLUENCE OF BETA-CAROTENE (OBTAINED FROM RED CARROT) ON REPRODUCTIVE PERFORMANCE OF SOWS

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90 multiparous sows were allotted into 3 groups (experimental groups I and II, and a control, group III, the last not being given beta-carotene). Sows from group I and II were given a feed mix containing dried red carrot, each receiving approximately 100 mg of beta-carotene per day. Group I was fed with that feed mix for 14 days before piglets were weaned and for 30 days after mating, as well from 101 to 110 days of gestation: group II was given beta-carotene from weaning the piglets to 14 days after mating, as 101 to 110 day of gestation. Beta-carotene has produced a favourable effect on the number of piglets born and reared as well on their body weight in the rearing period, the effect being dependent on the duration of supplementation.

INFLUENCE OF FERRODEX S ON THE BLOOD HEMATOLOGICAL AND BIOCHEMICAL COMPOSITION AS WELL AS ON THE GROWTH RESULTS OF PIGLETS

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Three groups of piglets (50 head per group) had Ferrodex S injected at 2–3 days of age. The 1st group of piglets received 200 mg each, the 2nd group 100 mg, the 3rd group 50 mg. Piglets in the 4th group did not get the preparation. At 60 days, the lowest body weight had piglets from the 4th group ($P < 0.01$). This group as well as piglets from the 3rd group had the lowest levels of haemoglobin, erythrocytes and Fe in the blood serum. Viability of these groups was the lowest. Application of 100 and 200 mg Fe per piglet was optimal for their growth and health.

FREQUENCY OF HAL GENOTYPE AND ITS INFLUENCE ON RESULTS OF FARROWING USAGE AND FATTENING AND SLAUGHTERING VALUE SWINES WBP AND PBZ FROM COUNTRYSIDE OPOLE

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Frequency of Hal genotypes in the Polish Large White and Polish Landrace from Opole was estimated using the DNA test. Landrace showed a higher frequency of genotypes N/n = 46.15, at allele frequencies $N = 0.44$, $n = 0.56$, then Large White which had frequency of genotypes N/n = 31.11, at allele frequencies $N = 0.84$, $n = 0.16$. Heterozygous sows have better results of farrowing. There was no significant influence of parent's genotype on the results of live offsprings' estimates.

COMPARISONS OF THE FREQUENCY OF GENOTYPES AT THE HAL LOCUS IN PIGS OF THE CZECH REPUBLIC AND POLAND

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Using the method of polymerase chain reaction (PCR) and restrictive fragment length polymorphism (RFLP), genotypes of the HAL locus in pigs in the Czech Republic and in Poland were determined. The pig population in Poland consisted of 230 pigs of the Polish Landrace (PBZ) and 110 pigs of the Polish Large White (WPB). From the breeding herds of Moravia and Eastern Bohemia, we studied 2 699 Large White pigs (BU) and 1 198 Landrace pigs (L). The frequency of genotypes and alleles in the respective breeds was as follows: BU: N/N = 87.03%; N/n = 12.63% and n/n = 0.34%; alleles: $N = 0.933$; $n = 0.067$. WPB: N/N = 75.45%; N/n = 24.55% and n/n = 0%; alleles: $N = 0.877$; $n = 0.123$. L: N/N = 56.51%; N/n = 37.90% and n/n = 5.59%; alleles: $N = 0.755$; $n = 0.245$. PBZ: N/N = 30.83%; N/n = 53.34% and n/n = 15.83%; alleles: $N = 0.575$; $n = 0.425$. Evaluation of the frequency of alleles in the studied breeds showed that the representation of the n allele was considerably lower in the Czech Republic than in Poland. Only in the WPB pigs was no recessive homozygous genotype n/n found.

Results were obtained on the basis of the NAZV MZe grant No. 5081/95.

VARIABILITY OF GENOTYPES AT THE RYR LOCUS IN THE LARGE WHITE PIG

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Genotypes at the locus RYR (HAL) were determined by the DNA test using the polymerase chain reaction (PCR), and subsequent fragmentation of the PCR products with restriction enzymes and electrophoretic differentiation of the DNA fragments (RFLP).

A total number of 2 699 Large White (BU) pigs was investigated. The frequency of genotypes and alleles were found as follows: Large White breed: N/N = 87.03%; N/n = 12.63% and n/n = 0.34%; alleles: $N = 0.933$; $n = 0.067$. Out of this number the breeding boars: N/N = 83.18%; N/n = 15.90% and n/n 0.92%; alleles: $N = 0.911$; $n = 0.089$. Breeding sows: N/N = 87.56%; N/n = 12.18% and n/n = 0.26%; alleles: $N = 0.937$; $n = 0.063$. Seven of the most numerous lines of boars and 10 breeding herds (ŠCH) with the highest number of sows were selected in order to get a better view of the situation during susceptibility to stress. The frequency of N/n heterozygotes in the selected lines of boars and in the breeding sows of the breeding herd ranged from 0 to 27.27% (with the exception of one old line where selection based on RYR had never been done), and 2 to 16%, respectively. This evaluation and also the frequency of RYR genotypes calculated for the entire population of breeding boars and sows showed that the frequency of heterozygous genotypes was higher in the boars, where much more emphasis is laid on the proportion of lean muscles than in sows. Comparisons with authors from abroad showed that the representation of the *n* allele in the Large White breed in the Czech Republic in the period 1994–1995 was found in the upper half of the range given by authors from abroad.

Results were obtained on the basis of grants NAZV MZe No. 5081/95 and GA ČR 1282/95.

EFFECT OF THE DELIVERY TIME OF PIGLETS ON THEIR REARING RESULTS

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The course of farrowing in 11 Polish Landrace sows of parity 2 was studied and recorded by time-lapse video. The study was conducted to find out the relationship between birth weight and interval between birth of piglets. Results indicate that birth weight of piglets had relationship to the interval of expulsion between two successive piglets (–0.293), and body weight at the 7th day after farrowing.

ASPECTS OF THE PIGLETS WEIGHT VARIABILITY AND THEIR SOLUTION

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In two feeding experiments with 129 piglets and in 3 balance periods with 10 piglets was tested the new feed mixture for 23 to 27-days-old weaned piglets. This new feed mixture was compared with feed mixtures usually used in practice. There was no significant difference in daily weight gain between the groups. The variability of the average daily weight gain over a 28-day period after weaning was 26.16% and 26.01% for experimental and 32.98% and 32.75% for control feed mixtures. Ileal digestibility value of crude protein was 83.97 ± 0.59%, nitrogen digestibility per 1 kg of body weight and day 0.84 ± 0.2 g and nitrogen retention 68.28 ± 0.95%.

METABOLIC PROFILE IN SOWS AND REPRODUCTION DISORDERS

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Failure of an early conception after farrowing represents a serious problem in intensive breeding of sows. At two large farms, 14 blood parameters in pregnant and lactating sows were estimated in testing the decrease in fertility. The most parameters were within standard values so that metabolic disorders did not play any major role in reproduction disorders. The main reason was a steady stress (high degree of noise, social distress, unsatisfactory ventilation and lighting). A mild hypoglycaemia together with hypomagnesaemia were the only additive factors in strengthening the effect of stress situation in dysfunction of the ovaries.

VARIABILITY OF INDICATORS OF THE CARCASS QUALITY OF PIGS WITH HETEROZYGOUS GENOTYPES AT THE RYR LOCUS (HAL)

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The objective of the study was to evaluate the variability of the main indicators of the carcass value in hybrid animals with heterozygous genotypes at the RYR locus (HAL). The results of fattening 20 hybrid male piglets after reciprocal crossing of the Large White (BU) and Landrace (L) breeds were investigated at the testing station for finishing capacity and carcass value. At a carcass weight of approx. 100 kg we evaluated the percentage of the main lean cuts, the area of the *musculus longissimus lumborum et thoracis* and the percentage of lean meat using the method of two points. The results showed highly significant differences between the two reciprocal hybrids after BU x L hybridization in all the three carcass value indicators, in favour of the male piglets.

Elaborated within the GACR grant No. 5081/95.

EFFECT OF RYANODINE RECEPTOR GENE STATUS ON SOME QUALITATIVE AND QUANTITATIVE TRAITS OF MEAT IN PIGS

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In two experiments of pigs with defined genotype (DNA based test on RYR 1 gene status) were divided in normal (non-mutant), heterozygotes (carriers, monomutant) and homozygote positive (dimutant).

The homozygote positive (dimutant) pigs had the lowest pH_1 and the highest R value, conductivity, reflectance, colour (Hunter), drip loss. Heterozygous animals were intermediate between both homozygotes for meat quality values. Yield and muscle area values of heterozygotes were closer to dimutant in one experiment and closer to normal pigs in a second experiment ($P > 0.05$).

Introducing the gene into a pig population could be useful in improving leaness and muscling but meat quality would deteriorate.

BREEDING OF PŘEŠTICE BLACK PIED PIGS IN GENETIC RESOURCE

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The Přeštice Black Pied breed is endangered. Feed conversion and carcass value of F_1 generation and final hybrids, and the results of instrumental classification of hybrid pig carcasses were analysed.

The crossbreds Přeštice Black Pied x Landrace had more favourable (non-significantly) results both litter size and live-born piglets than Large White x Landraces. There was a higher level of fattening performance and carcass value in F_1 generation of pigs originating from a reproduction herd and classed with position B in the hybridization programme for Large White x Landraces compared with Přeštice Black Pied x Landraces.

10% of Large White x Landrace carcasses and only 5% of Přeštice Black Pied x Landrace carcasses contained PSE meat. The effect of Přeštice Black Pied breed on a lower incidence of PSE meat in the carcass was proved.

ASCARIASIS IN PIG NUCLEUS AND FATTENING HERDS

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Different technologies in pig herds and differences in production intensity create distinct conditions for pig *Ascariasis* transfer. The spreading of parasites on a farm is enabled by an ignorance of the infection source and positive pig transport. The study of prevalence demonstrated 3,30%; 3,70% and 7,70% in three large herds and 5,13%; 8,30%; 16,70 %; 23,44% in four small herds. In the nucleus herds *Ascariasis* spreads without any prevention with gilt soles. Repeating level of *Ascariasis* prevalence was found in individual halls from 3,68% to 52,03%. The fattening herds are economically more affected than the nucleus ones. An increased level of *Ascariasis* caused by mistakes in management was proved.

GROWTH OF PŘEŠTICE BLACK PIED PIGS

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The growth of Přeštice Black Pied pigs from 70 to 180 days of age was studied. Average daily gains for 10-day intervals were determined, and based on these, the regression of daily gain on age was estimated as follows:

$y = -356.4 + 16.6206x - 0.057762x^2$

Comparison with other pig populations proved early maturity of Přeštice Black Pied breed. This is a disadvantage when animals are fed to higher slaughter weights.

LEVEL OF SINGLE REPRODUCTIVE TRAITS IN SOWS WITH RESPECT TO THEIR AGE AT THE FIRST MATING AND LITTER PARITY

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In the reproductive herd of sows of Large White breed (LW) mated with Landrace boars (L), 280 litters from 56 sows were investigated over 5 parities, and the total number of piglets was 2 751.

The group of 56 sows was divided by the age at the first mating into following subgroups: less than 240 days, 241 to 255 days, 256 to 270 days, 271 to 300 days and 301 and more days. The sows first mated at the age of 10 months had the highest level of reproductive performance in the 1st to 5th litters by the parity. The highest fertility (11.86 of all piglets born in the litter) was found for the 4th litters. The third to fifth litters showed the highest piglet mortality at birth. Along with the increasing litter parity, the birth weight of piglets and their growth ability up to the age of 28 days increased.

FACTORS INFLUENCING THE GROWTH OF PIGLETS DURING REARING TO THE AGE OF 56 DAYS

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The individual birth weight, body weight at the age of 21 days and at weaning at 56 days was investigated under the conditions of a commercial herd in the group of 418 hybrid piglets (LW x L) x L. The mean liveweight of piglets was 1.57 kg at birth, 5.92 kg at 21 days, and 15.47 kg at weaning at 56 days of age. In comparison with the gilts the barrows had always higher liveweight. During rearing the effect of litter parity on the increasing liveweight of piglets both by sex and irrespective of the sex was proved.

THE INFLUENCE OF BROWN COAL FROM DIFFERENT MINES ON REARING RESULTS OF PIGLETS

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The aim of investigations was to check influence of coal from three mines on rearing results suckling and weaned piglets, haematological indicators and health. From the 10th day piglets got prestarter *ad libitum* and had free access to coal. Coal was eaten readily by piglets. In the first weeks of life piglets ate more coal than prestarter. There was no statistically important influence of coal from different mines on daily gain. However animals which were getting coal had in the 8th week of life body weight higher by 3.8–10% than the control group. There was no real influence of coal on haematological blood traits.

THE EFFECT OF PRODUCTS OBTAINED AT MULTIPLICATION OF *PIPTOPORUS BETULINUS* ON REARING RESULTS OF PIGLETS. HAEMATOLOGICAL RESEARCH AND SPECIFIC HUMORAL RESPONSE IN PIGLETS RECEVING *P. BETULINUS*

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It was found that preparations with *P. betulinus* decreased mortality rate in piglets. Immunological humoral response to ovalbuminum was the lowest in group which was getting metabolites of *P. betulinus* grown on a glucoso-peptonose medium.

THE CHANGES OF OESTRADIOL-17β LEVELS AND VAGINAL IMPEDANCE IN THE FINAL STAGES OF PREGNANCY IN SOWS

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The aim of this study was to investigate the changes of oestradiol levels in jugular plasma and vaginal impedance in pregnant sows. The vaginal impedance was measured by a four-electrode method. Concentrations of oestradiol in blood plasma were determined by a direct RIA method. Impedance and oestradiol measurements were carried out every 5 days from the 60th day of pregnancy to farrowing. A significant decrease of vaginal impedance during the last third of pregnancy was recorded ($P < 0.05$). Plasma concentrations of oestradiol increased gradually in the course of the last weeks of pregnancy ($P < 0.05$). The results indicate that marked changes of vaginal impedance and plasma oestradiol levels occur during the last third of pregnancy in the sows.

DEPOSITION OF CRUDE PROTEIN IN PIGS OF DEFINED GENOTYPE

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Limits of efficient deposition of crude protein as a qualitative criterion of meat production has been evaluated at a balance trial with 8 pigs (average body weight 48 kg) of a defined genotype. The isoenergetical feed mixtures were used in the trial and uptake of crude protein and amino acids were screened (crude protein 230,6–326,8 g daily, LYS 14,1–20,9 g daily). The limit of an efficient deposition of 160 g of crude protein daily has been achieved by crude protein uptake of 311 g and LYS of 19,1 g daily. The daily gain average has been 752 g and feed conversion 2,11 kg. A higher uptake of crude protein as well as amino acids influenced the deposition of crude protein only slightly, but the utilisation of nitrogen and productivity of feed mixtures were visibly worse.

GLYCOLYTIC POTENTIAL AND LACTATE LEVEL MEASURED *IN VIVO* AND MEAT QUALITY *POST MORTEM* OF PIGS WITH HAL^NHAL^n AND HAL^NHAL^N GENOTYPES

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The aim of the study was to compare HAL^NHAL^N and HAL^NHAL^n genotypes on the basis of glycolytic potential and lactate level measured in biopsy samples and also meat quality *post mortem*. A total 39 animals were evaluated with the following genotypes: 19 – NN and 20 – Nn. In biopsy samples taken at 70–80 kg live weight from the *longissimus lumborum* muscle the glycolytic potential (GP) and lactate (L) were evaluated. For 11 pigs with NN genotype and 12 Nn the samples were incubated around 30 minutes. Meat quality after slaughter were estimated on the basis of pH_1, pH_{24}, R_1 (IMP/ATP), muscle lightness and WHC in the *longissimus dorsi* muscle. For biopsy parameters (GP and L) significant differences were observed only for lactate level in incubated as well as non incubated samples. The results of meat quality traits evaluated *post mortem* showed differences between NN and Nn pigs for pH_1 and R_1 values.

EFFECT OF THE RYR1 GENE ON THE CARCASS COMPOSITION AND MEAT QUALITY OF POLISH LANDRACE PIGS

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The aim of the study was to evaluate the effect of the RYR1 (HAL) genotype on carcass and meat quality in Polish Landrace pigs. The investigations covered 96 pigs. The animals (20 stress resistant pigs RYR^CRYR^C – NN; 54 heterozygous RYR^CRYR^T – Nn and 22 stress susceptible RYR^TRYR^T – nn) were derived from mating of heterozygous parents – 1 boar with 20 sows. Pigs were killed at 100kg live weight. The results showed that heterozygous pigs were not significantly different from NN in average backfat thickness and pH_1 or from nn pigs in weight of ham but were intermediate for all other studied traits between both homozygous types.

THE USE OF SIRE POPULATIONS WITH HIGH PROPORTION OF LEAN MEAT FOR PRODUCTION OF FINAL HYBRIDS

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Evaluation of final hybrids sired by line 16 boars and hybrid boars resulting from crossing of Piètrain pigs and pigs from a special subpopulation of Large White breed was carried out. An exceptional level of fleshing caused by used sires is documented by the proportion of muscle in the carcass in slaughtered progeny. The average value reached 53.81 ± 0.367% for the first and 54.61 ± 0.298% for the second group.

THE ASSESSMENT OF MILK PERFORMANCE IN PIG POPULATIONS IN THE CZECH REPUBLIC

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Milk production of sows of dam breeds (LW, L, Pc) and of sows of sire breeds (H, D, LB) was studied over the period 1982–1994. The most positive development of values was for LW and L breeds of dam breeds to 1990. The number of surviving piglets had been rising from 1983. From 1989 to 1993 the number did not change and in 1994 it dropped.

An increase of milk production of sire breeds stopped in 1988. The subsequent gradual drop of milk production stopped in 1991, when an improvement started again. The development of number of surviving piglets resembled the curve for milk production.

THE RELATIONSHIP BETWEEN VAGINAL AND VESTIBULAR IMPEDANCE DURING THE OESTROUS CYCLE IN SOWS

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The aim of this study was to investigate the changes of vaginal and vestibular impedance during the oestrous cycle in sows. Vaginal impedance was measured by a four-electrode method. Vestibular impedance was measured by a two-electrode method. Impedance measurements were carried out once a day from weaning to the 17th day after oestrus onset. After weaning, a fall in vaginal impedance was recorded ($P < 0.01$). The lowest values of vaginal impedance were observed 1–2 days before oestrus. A marked increase in vaginal impedance followed during oestrus ($P < 0.01$). In the course of dioestrus no changes in the vaginal impedance were recorded. No changes of vestibular impedance from weaning to oestrus onset were observed. During oestrus a marked increase of vestibular impedance was found. The highest values of vestibular impedance were obtained 48 hours after oestrus onset ($P < 0.01$). At the beginning of dioestrus vestibular impedance declined ($P < 0.01$) and then no changes were observed. In conclusion, our results indicate that the changes of vaginal impedance start before the beginning of oestrus, and the changes of vestibular impedance start after oestrus onset in cyclic sows.

INDUCTION OF OESTRUS AND OVULATION IN ANESTROUS GILTS AND SOWS

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Oestrus was induced in anestrous pubertal gilts and in sows with weaned piglets. Cycles of gilts were blocked with Regumate or Evertas-P for 15 days; then one dose of 1 000 I.U. PMSG + 500 I.U. HCG (serum gonadotrophin and Praedyn) or 500 I.U. PMSG + 300 I.U. HACG was administered. A similar hormonal treatment was applied in sows. Results were compared to reproduction traits and natality rate recorded in the remaining part of the herd. In the final phase of the study, the mentioned regime without the 500 I.U. PMSG + 300 I.U. HCG was used in other herds. No significant differences were found among individual groups. Higher doses of hormonal preparations resulted in higher rates of sows or gilts manifesting outstanding heat and in a higher conception rate; in animals treated with lower hormonal doses a higher natality was recorded.

CRYOPRESERVATION OF PORCINE EMBRYOS

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Experimental cryopreservation of porcine embryos has been unsuccessful until lately. In our experiment, donors were treated with Evertas-P combined PMSG-HCG-LHRH.

Recovery term was specified experimentally (4 days and 17 hours after 1st insemination); 83% embryos characterized with optimum evolution stage (perihatching blastocysts) were recovered.

Three vitrification media were tested:

a) vitrification medium specified in papers of Říha et al. (1989), Říha (1990, 1993)
b) vitrification medium composed of 50% glycerol in cultivation medium + 20% FCS
c) vitrification medium composed of 25% ethylenglycol + 25% DMSO in M199 in cultivation medium + 20% FCS-VS.

Results demonstrated a satisfactory morphological condition of embryos after thawing and washing in case of medium (a). Embryo vitrification in 50% glycerol was also successful. Application of medium (c) requires equilibration (7 min at minimum) and vitrification (1.5 min). Intensity of nuclear RNA synthesis corresponds with good morphological conditions of thawed embryos. Five recipients (2 noninseminated and 3 inseminated) were used for ET. Transfer of 13–16 embryos was favourable in 1 noninseminated and 1 inseminated recipient. The inseminated one gave birth to 7 piglets (6 live born), a noninseminated recipient aborted. Two piglets born from cryopreserved embryos were a different phenotype.

THE CONDITION OF REPRODUCTIVE ORGANS IN YOUNG BREEDING BOARS WITH RESPECT TO FEEDING LEVELS

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The condition of reproductive organs was studied in a total of 54 German Landrace breeding boars, aged 5, 6 and 7 months, at feeding levels different from the 14th week of age. Control animals were fed standard diet (100%), experimental group I was given rations decreased by 20% and experimental group II was fed diet increased by 20%.

Studies have shown that various dietary levels affected the growth and weight gains of boars including the development of reproductive organs. Gains in body weight and weights of testes, epididymides, vesicular glands, prostate gland and bulbo-urethal glands as well as enlarged size of these organs were the highest in experimental group II, and the lowest in experimental group I, compared with the controls.

PORCINE REPRODUCTIVE AND RESPIRATOTY SYNDROME (PRRS) IN THE CZECH REPUBLIC

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The first demonstration of PRRS virus in swine herds in the Czech Republic dates back to 1995. Methods of virus propagation in cultures of PLM and the cell line MARC-145 have been adopted and indirect immunofluorescence and direct and indirect immunoperoxidase tests were used for virus demonstration. Methods of reverse transcription and subsequent polymerase chain reaction (RT-PCR) were developed for the demonstration of viral nucleic acid. The presence of PRRS virus in three swine herds was confirmed using this technique. ELISA for antibodies to PRRS virus (IDEXX kit) has so far yielded positive results in 21 swine herds.

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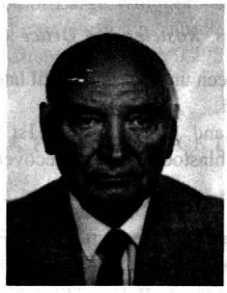
NEKROLOG

Za prof. Ing. Lubomírem Kratochvílem, DrSc.



Dne 3. ledna 1997 náhle zemřel ve věku 69 let prof. Ing. Lubomír Kratochvíl, DrSc. Pocházel z Kněžmostu, z rodiny drobného rolníka. Vystudoval Vysokou školu zemědělskou v Praze v letech 1946 až 1950 a pokračoval ve studiu vědecké aspirantury v oboru mlékařství. Potom až do roku 1964 pracoval jako vedoucí vědecký pracovník ve Výzkumném ústavu mlékařském v Praze. Ve stejném roce nastoupil na VŠZ v Praze jako odborný asistent. V roce 1967 se habilitoval pro obor mlékařství a byl jmenován a ustanoven docentem. V roce 1978 byl jmenován profesorem pro obor speciální zootechnika – mlékařství. V roce 1983 obhájil doktorskou disertační práci.

Na Vysoké škole zemědělské zastával funkci proděkana Agronomické fakulty pro obor zootechnický a vedoucího katedry chovu skotu a mlékařství. Po dobu dvou let (1963/1964) pracoval jako expert v mlékárenském závodě v Kyritz v Německu. V letech 1973 a 1974 působil jako expert pro živočišnou výrobu na úřadě pro chov skotu při Ministerstvu zemědělství v Tunisu.

Prof. Kratochvíl publikoval 110 původních vědeckých prací, z nichž 18 bylo uveřejněno v zahraničí. Je spoluautorem osmi patentů, pěti knižních publikací a řady odborných článků a učebních textů z oboru mlékařství. Absolvoval několik přednáškových pobytů v zahraničí.

Byl dlouholetým členem vědecké rady VŠZ AF a členem vědecké rady Výzkumného ústavu mlékárenského v Praze. Byl předsedou sekce technologie výroby mléčných výrobků Národního komitétu mezinárodní mlékařské federace. Byl dopisujícím členem ČSAZ a členem odboru živočišné výroby ČSAZ, členem redakčních rad časopisů Živočišná výroba, Náš chov a Průmysl potravin. Byl předsedou komise pro obhajoby doktorských disertačních prací v oboru zootechnika.

Jeho vědecká i pedagogická práce byla oceněna řadou vyznamenání.

V osobě prof. Ing. Lubomíra Kratochvíla, DrSc., ztrácíme dobrého pedagoga, odborníka, přítele a skromného člověka.

Spolupracovníci
z katedry chovu skotu a mlékařství
České zemědělské univerzity v Praze

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Časopis uveřejňuje původní vědecké práce, krátká sdělení a výběrově i přehledné referáty, tzn. práce, jejichž podkladem je studium literatury a které shrnují nejnovější poznatky v dané oblasti. Práce jsou uveřejňovány v češtině, slovenštině nebo angličtině. Rukopisy musí být doplněny krátkým a rozšířeným souhrnem (včetně klíčových slov).

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Rozsah vědeckých prací nemá přesáhnout 15 stran psaných na stroji včetně tabulek, obrázků a grafů. V práci je nutné používat jednotky odpovídající soustavě měrových jednotek SI (ČSN 01 1300).

Vlastní úprava rukopisu má odpovídat státní normě ČSN 88 0220 (formát A4, 30 řádek na stránku, 60 úhozů na řádku, mezi řádky dvojité mezery), k rukopisu je vhodné přiložit disketu s prací pořízenou na PC v některém textovém editoru, nejlépe v T602, a s grafickou dokumentací. Tabulky, grafy a fotografie se dodávají zvlášť, nepodlepují se. Na všechny přílohy musí být odkazy v textu.

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Krátký souhrn (Abstrakt) je informačním výběrem obsahu a závěru článku, nikoliv však jeho pouhým popisem. Musí vyjádřit všechno podstatné, co je obsaženo ve vědecké práci, a má obsahovat základní číselné údaje včetně statistických hodnot. Musí obsahovat klíčová slova. Nemá překročit rozsah 170 slov. Je třeba, aby byl napsán celými větami, nikoliv heslovitě. Je uveřejňován a měl by být dodán ve stejném jazyce jako vědecká práce.

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Úvod má obsahovat hlavní důvody, proč byla práce realizována a velmi stručnou formou má být popsán stav studované otázky.

Literární přehled má být krátký, je třeba uvádět pouze citace mající úzký vztah k problému.

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Diskuse obsahuje zhodnocení práce, diskutuje se o možných nedostatcích a práce se konfrontuje s výsledky dříve publikovanými (požaduje se citovat jen ty autory, jejichž práce mají k publikované práci bližší vztah). Je přípustné spojení v jednu kapitolu spolu s výsledky.

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Na zvláštním listě uvádí autor plné jméno (i spoluautorů), akademické, vědecké a pedagogické tituly a podrobnou adresu pracoviště s PSČ, číslo telefonu a faxu, popř. e-mail.

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Original scientific papers, short communications, and selectively reviews, that means papers based on the study of technical literature and reviewing recent knowledge in the given field, are published in this journal. Published papers are in Czech, Slovak or English. Each manuscript must contain a short and a longer summary (including the key words).

The author is fully responsible for the originality of his paper, for its subject and formal correctness. The author shall make a written declaration that his paper has not been published in any other information source.

The board of editors of this journal will decide on paper publication, with respect to expert opinions, scientific importance, contribution and quality of the paper.

The paper extent shall not exceed 15 typescript pages, including tables, figures and graphs.

Manuscript layout shall correspond to the State Standard ČSN 88 0220 (quarto, 30 lines per page, 60 strokes per line, double-spaced typescript). A PC diskette should be provided with the paper, written in an editor program, preferably T602, and with graphical documentation. Tables, figures and photos shall be enclosed separately. The text must contain references to all these annexes.

The **title** of the paper shall not exceed 85 strokes. Subtitles of the papers are not allowed either.

Abstract is an information selection of the contents and conclusions of the paper, it is not a mere description of the paper. It must present all substantial information contained in the paper. It shall not exceed 170 words. It shall be written in full sentences, not in form of keynotes, and comprise base numerical data including statistical data. It must contain key words. It should be submitted in English and if possible also in Czech or Slovak.

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Review of literature should be a short section, containing only literary citations with close relation to the treated problem.

Only original method shall be described, in other cases it is sufficient enough to cite the author of the used method and to mention modifications of this method. This section shall also contain a description of experimental material.

In the section **Results** figures and graphs should be used rather than tables for presentation of quantitative values. A statistical analysis of recorded values should be summarized in tables. This section should not contain either theoretical conclusions or deductions, but only factual data should be presented here.

Discussion contains an evaluation of the study, potential shortcomings are discussed, and the results of the study are confronted with previously published results (only those authors whose studies are in closer relation with the published paper should be cited). The sections Results and Discussion may be presented as one section only.

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The author shall give his full name (and the names of other collaborators), academic, scientific and pedagogic titles, full address of his workplace and postal code, telefon and fax number or e-mail.

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