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EFFECT OF GENOTYPE, SEX AND LITTER SIZE ON GROWTH AND BASIC TRAITS OF CARCASS QUALITY OF LIGHT LAMBS

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Abstract

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Evaluation of the effect of genotype (Romanov breed: n = 26, and F1 crossbreds of Suffolk-Romanov: n = 29), sex (males: n = 37 and females: n = 18) and litter size (singles: n = 6, twins: n = 16, triples: n = 21 and quadruplets: n = 12) on growth and basic carcass quality traits of light lambs was carried out at an organic sheep farm in Kuklík over the years 2007 and 2008. Throughout the experiment the lambs were reared with their mothers, indoors. The weaning of lambs was carried out just before slaughter. The daily feeding ration of the lambs consisted of the mother's milk (*ad libitum*) and organic mineral lick (*ad libitum*), whereas the lambs had free access to the feedstuff of their mothers. The daily feeding ration of the ewes consisted of haylage (2.5 kg/ewe), meadow hay (*ad libitum*) and organic mineral lick (*ad libitum*). The genotype (G) and the sex (S) had not a significant effect on growth of lambs in the period from birth till the slaughter. On the other hand the litter size (LS) had a highly significant effect on this trait, whilst the highest daily gain in above-mentioned period was found in singles (157 g). Concerning the carcass traits the G had a significant effect only on carcass dressing percentage while the S had a significant effect only on proportion of kidney. Nevertheless the LS had a significant effect on carcass dressing percentage and the proportions of skin, kidney and kidney fat. In conclusion it can be completed that the fatness scores of all individual carcasses were relatively very low which is important for good realisation of the carcasses on the market.

lamb, Romanov, Suffolk, growth, carcass quality

The main product in Czech sheep breeding are hard lambs whereas majority of lambs is slaughtered in live weights higher than 30 kg. On the other hand the production of so called „light lambs", which are the lambs with lower carcass weights than 13 kg, is in the Czech Republic, compared to for example Italy, Spain or Slovakia, minor. This fact is above all affected by relatively low number of breeds or crossbreds which are fit for this production and relatively low interest of breeders in intensive or semi-intensive fattening, which are for this production recommended. Nevertheless in this context it is necessary to complete, that production of light lambs is, above all in southern european countries, very prefered namely for good economy. By the way, the main strenghts of this production consist in relatively low consumption of fodder and roughage, short period of fattening and relatively good prices for light lambs in the market. However, regarding the tendencies during last tree-four years in Czech sheep breeding, the numbers of dairy sheep and Romanov (RO) breed, which are very suitable for production of light lambs, had increased and presently we can meet this production in Czech farms even more frequently.

Romanov breed belongs to most important prolific breeds. On the other hand for this breed is characteristic lower growth ability and worse carcass quality compared to most of the dual-purpose and special meat sheep breed. One of the most important possibility how to improve growth or carccas quality in RO lambs consists in using of commercial

crossing with the special meat breeds. In this regard the ewes of Romanov breed are most frequently crossed with Suffolk sires in the CR. The growth of different crossbreds with Romanov breed in CR was evaluated by Fantová and Čislíkovská (1991). Abroad the growth of the different crossbreds with Romanov was assessed by Kridli *et al.* (2007). The growth of lambs can be also affected by sex and litter size, whilst this subject in crossbreds of Awassi x RO and Charollais x RO was studied by Shaker *et al.* (2002).

The carcass and meat quality of light lambs is affected by a lot of different factors whilst the most important factors are genotype, nutrition, slaughter weight and sex. The effect of four different breeds on carcass and meat quality of light lambs was assessed by Sanudo *et al.* (1997). Burke *et al.* (2003) evaluated the effect of different crossbreds with Romanov on basic carcass traits. On the other hand the effects of slaughter weight and sex on carcass traits and meat quality in light lambs were evaluated by Pena *et al.* (2005), Perez *et al.* (2006) and Santos *et al.* (2007).

The main aim of our experiment was to evaluate effect of genotype, sex and litter size on growth and basic traits of carcass quality of so called „light lambs", which were reared under organic conditions.

MATERIAL AND METHODS

The experiment was carried out at an organic sheep farm in Kuklík located in region Vysočina in the Czech Republic over the years 2007 and 2008. The farm is situated at the altitude of 680 m above the sea level with an average annual temperature of 6.8 °C and precipitation of 965 mm. The experimental animals were purebred lambs of Romanov (RO, n = 26) and F1 crossbreds of Suffolk-Romanov (SF 50 RO 50, n = 29). Most of interaction (for example genotype x sex, genotype x litter size etc.) had not a significant effect on growth and carcass quality traits. For this reason only the effects of sex (males: n = 37, females: n = 18) and litter size (singles: n = 6, twins: n = 16, triples: n = 21 and quadruplets: n = 12) for the whole population were evaluated.

All lambs were born indoors from December 15 (2007) till January 17 (2008). During the period from their birth until slaughter, all of the lambs were reared indoors with their mothers. The weaning of lambs was carried out just before slaughter. During the experiment the daily feeding ration of the lambs consisted of the mother's milk (*ad libitum*) and organic mineral lick (*ad libitum*) whereas the lambs had free access to the feedstuff of their mothers. The daily feeding ration of the ewes in the same period consisted of haylage (2.5 kg/ewe), meadow hay (*ad libitum*) and organic mineral lick (*ad libitum*). During the experiment, all of the lambs were reared in one flock under identical conditions without any discernible differences in nutrition or management.

The first weighing of the lambs was carried out till 24 hours after parturition. Simultaneously the sex and the litter size of the lambs were recorded. Next weighing of lambs was carried out just before slaughter. The meat production characteristics such as live weight (LWS), age at slaughter, average daily gain (ADG) and the proportion of skin were evaluated on the day of slaughter. Meat colour and fatness of carcasses were also subjectively assessed on the day of the slaughter. On the following day, after a chilling period of approximately 24 hours, the cold carcass weight (CCW), dressing percentage of cold carcass weight and the contents of kidney and kidney fat were evaluated. The skin percentage was determined as the ratio of the weight of skin to the live weight of lambs. The dressing percentage of cold carcass weight was determined as the ratio of cold carcass weight (CCS) to the slaughter weight. The kidney percentage was determined as the ratio of the weight of kidney to the weight of CCW. The kidney fat percentage was determined as the ratio of the weight of kidney fat to the weight of CCW. In fine to slaughter procedure it is necessary to complete that in our experiment was not carried out cutting of carcasses to the standardized commercial joints with regard to relatively low carcass weights.

Meat colour and fatness of individual carcasses were determined using the Community scale for carcass classification of light lamb (The Council Directive 92/2137/EEC). Meat colour was assessed subjectively, whilst in all individual carcasses in our experiment were found only the classes „light pink" and „pink" (Table I.). Fatness of carcases was assessed using a scoring system that took into account the carcass as a whole, as well as the quantity of kidney knob and channel fat. Nevertheless in all individual carcasses in our experiment were found out only the classes „low" and „slight fatness". The classification scheme for statistical analysis of meat colour and fatness is presented in Table I.

I: *The classification scheme for statistical analysis of meat colour and fatness*

Meat colour score	Class for statistical analysis	Fatness score	Class for statistical analysis
Light pink	1	Low fatness	1
Pink	2	Slight fatness	2

Recorded data were statistically analysed using the least-squares method (SAS; PROC GLM variant ss4). The systematic effects were genotype (2 classes), sex (2 classes) and litter size (4 classes). Statistical analysis was carried out using the mathematical-statistical programme SAS version 9.1.3.

RESULTS AND DISCUSSION

The genotype (G) had not a significant effect on daily gain from birth till the slaughter (Table II) which is in agreement with Kridli *et al.* (2007), Costa *et al.* (2009) and Petr *et al.* (2009). On the other

hand Fantová and Čislíkovská (1991), Freking and Leymaster (2004) and Kuchtík *et al.* (2010) reported a significant effect of genotype on growth. In our experiment the crossbreds of SF x RO had a significantly higher birth weight, however their daily gain from birth till the slaughter was non-significantly lower compared to RO purebred lambs. The lower daily gain in crossbreds with SF compared to purebred RO lambs was not expected however Shaker *et al.* (2002) in crossbreds of Awassi x RO found out higher daily gain compared to crossbreds of Charollais x Awassi whereas the Charollais breed belongs to the most important special meat breeds and Awassi breed is ranked among mixte breeds. Further it is necessary to state that in our experiment in both genotypes were found out relatively low daily gains. This fact was above all affected by extensive fattening of lambs and also by relatively high numbers of triples and quadruplets in both groups of lambs. The S had not a significant effect on growth which is in agreement with the results published by Giouzelyannis *et al.* (1997) and Kuchtík *et al.* (2010). On the other hand Dobeš *et al.* (2007) and Cloete *et al.* (2007) reported a significant effect of this factor on growth of lambs. Anyway it can be stated that the males had higher daily gain compared to females as expected.

The LS had a significant effect on growth of lambs whilst the highest daily gain was found in singles. Both these findings correspond with results published by Shaker *et al.* (2002) and Kuchtík *et al.* (2010). However the second highest daily gain was found in quadruplets whilst the lowest daily gain was found in twins. Nevertheless Shaker *et al.* (2002) and Kuchtík *et al.* (2010) found the second highest daily gain in twins.

The effect of G, S and LS on basic carcass traits, fatness and meat colour of carcasses is presented in table III. From this table results that the G had a significant effect only on dressing percentage (DP). Also Morbidini *et al.* (2005) and Pena *et al.* (2005) reported a significant effect of the G on this trait. In our experiment a significantly higher DP was found in crossbreds compared to purebred lambs which can be explained as the results of heterosis effect. The levels of DP in both genotype in our experiment were markedly lower compared to Pérez *et al.* (2007) and Santos *et al.* (2007). On the other hand Zapletal *et al.* (2010) in different crossbreds with Suffolk reported comparable values of DP.

The genotype had not a significant effect on fatness (F) and meat colour (MC). By contrast Sanudo *et al.* (1997) and Juarez *et al.* (2009) reported a significant effect of this factor on the fatness of light lambs, however in their studies were found markedly higher fatness scores compared to our results. Nevertheless in both above-mentioned studies was carried out relatively intensive fattening of lambs. So the markedly lower fatness of caracasses in our experiment was, in our opinion, above all affected by extensive fattening of lambs.

The S had not a significant effect on DP, F and MC which is in the case of DP in agreement with Santos *et al.* (2007) and Pérez *et al.* (2007). Nevertheless Pena *et al.* (2005) did not find the effect of sex on DP and MC, but they reported a significant effect of this factor on F. In our experiment the higher DP and F were found in males, while this groupe of lambs had lighter colour of meat compared to females. On the other hand Pena *et al.* (2005) found out in females higher DP and F, nevertheless in the case of MC their finding is in agreement with our result.

The LS had a significant effect on DP and its highest value was found in singles whilst both these findings are in agreement with Kuchtík *et al.* (2010). On the other hand the LS had not a significant effect on F and MC. However the lowest fatness was found in singles whereas in this group was found the darkest MC. By contrast the most light colour of cacasses was found in quadruplets.

The G had not a significant effect on skin, kidney and kidney fat percentages (Table IV). On the other

II: *Effect of genotype, sex and litter size on birt weight, slaughter weight, daily gain and age at slaughter*

	Birth weight (kg)	Slaughter weight (kg)	Daily gain from birth till the slaughter (g)	Age at slaughter (days)
	L.S.M. ± S.E.M.	**L.S.M. ± S.E.M.**	**L.S.M. ± S.E.M.**	**L.S.M. ± S.E.M.**
Genotype	*	n.s.	n.s.	n. s.
RO (A)	2.66 ± 0,08 ^{b}	14.06 ± 0.57	138 ± 4.51	82.4 ± 2.57
SF x RO (B)	2.93 ± 0,08 ^{a}	13.86 ± 0.54	131 ± 4.31	83.3 ± 2.46
Sex	n.s.	n.s.	n.s.	n.s.
Males (A)	2.87 ± 0,06	14.35 ± 0.46	140 ± 3.65	81.9 ± 2.08
Females (B)	2.72 ± 0,09	13.58 ± 0.65	129 ± 5.19	83.9 ± 2.96
Litter size	**	**	**	n. s.
Singles (A)	3.80 ± 0.16 ^{BCD}	16.29 ± 1.10 ^{bC}	157 ± 8.76 ^{BC}	79.6 ± 5.00
Twins (B)	2.96 ± 0.09 ^{ACD}	13.10 ± 0.65 ^{a}	120 ± 5.15 ^{A}	84.6 ± 2.94
Triples (C)	2.32 ± 0.08 ^{AB}	12.75 ± 0.58 ^{A}	127 ± 4.66 ^{A}	82.4 ± 2.66
Quadruplets (D)	2.10 ± 0.11 ^{AB}	13.71 ± 0.77	136 ± 6.12	85.5 ± 3.49

n. s. = nonsignificantly different; *, a, b = P≤ 0.05, * *, A, B, C, D = P ≤ 0.01

III: *Effect of genotype, sex and litter size on basic carcass traits, fatness and meat colour of carcasses*

	Slaughter weight (kg)	Cold carcass weight (kg)	Dressing percentage (%)	Fatness (points)	Meat colour (points)
	L.S.M. ± S.E.M.	L.S.M. ± S.E.M.	L.S.M. ± S.E.M.	L.S.M. ± S.E.M.	L.S.M. ± S.E.M.
Genotype	**n.s.**	**n.s.**	*****	**n.s.**	**n.s.**
RO (A)	14.06 ± 0.57	5.67 ± 0.22	40.25 ± 0.60 ^{b}	1.15 ± 0.09	1.32 ± 0.11
SF x RO (B)	13.86 ± 0.54	5.84 ± 0.21	42.17 ± 0.57 ^{a}	1.24 ± 0.09	1.53 ± 0.10
Sex	**n.s.**	**n.s.**	**n.s.**	**n.s.**	**n.s.**
Males (A)	14.35 ± 0.46	5.92 ± 0.18	41.31 ± 0.48	1.28 ± 0.07	1.41 ± 0.09
Females (B)	13.58 ± 0.65	5.58 ± 0.25	41.11 ± 0.69	1.11 ± 0.11	1.45 ± 0.12
Litter size	******	******	*****	**n.s.**	**n.s.**
Singles (A)	16.29 ± 1.10 ^{bC}	6.95 ± 0.43 ^{BCd}	42.74 ± 1.16 ^{b}	1.00 ± 0.18	1.61 ± 0.21
Twins (B)	13.10 ± 0.65 ^{a}	5.17 ± 0.25 ^{A}	39.46 ± 0.68 ^{ad}	1.23 ± 0.11	1.43 ± 0.12
Triples (C)	12.75 ± 0.58 ^{A}	5.15 ± 0.23 ^{A}	40.51 ± 0.62	1.18 ± 0.10	1.38 ± 0.11
Quadruplets (D)	13.71 ± 0.77	5.74 ± 0.30 ^{a}	42.15 ± 0.81 ^{b}	1.36 ± 0.12	1.29 ± 0.15

n.s. = nonsignificantly different; *, a, b, c, d = P ≤ 0,05, * *, A, B, C = P ≤ 0,01

hand Sanudo *et al.* (1997) found out a significant effect of the G on percentages of kidney and kidney fat, whereas Zapletal *et al.* (2010) found out a significant effect of this factor on percentage of kidney fat. In fine it is necessary to complete that the percentages of kidney and kidney fat in our experiment were markedly lower compared to Sanudo *et al.* (1997) whereas in our experiment were found higher percentages of kidney and kidney fat in SF x RO crossbreds.

The S had a significant effect on kidney percentage whilst this factor had not a significant effect on skin and kidney fat percentages. On the other hand Pérez *et al.* (2007) found a significant effect of this factor on kidney and kidney fat percentages, whilst Pena *et al.* (2005) determined a significant effect of sex on kidney fat percentage. From table IV. also results that the percentages of skin, kidney and kidney fat were higher in males which is, concerning kidney percentage, in agreement with Pérez *et al.* (2007). Nevertheless Peña *et al.* (2005) reported that the percentages of kidney are the same in both sex, but in the case of kidney fat percentage they found out its percentage a significantly higher in females. In fine of this part it can be state that the percentages of kidney and kidney fat were in our experiment relatively very low. In our opinion this fact was above all affected by extensive nutrition of lambs.

The LS, compared to effect of the G or the S, had a significant effect on percentages of skin, kidney and kidney fat. The highest percentages of skin and kidney were found in triples whilst the highest percentage of kidney fat was found in quadruplets. On the other hand the lowest percentages of kidney and kidney fat were found in singles whilst the lowest percentage of skin was found in twins.

IV: *Effect of genotype, sex and litter size on weight of skin and percentages of skin, kidney and kidney fat*

	Weight of skin (kg)	Skin (%)	Kidney (%)	Kidney fat (%)
	L.S.M. ± S.E.M.	L.S.M. ± S.E.M.	L.S.M. ± S.E.M.	L.S.M. ± S.E.M.
Genotype	**n.s.**	**n.s.**	**n.s.**	**n.s.**
RO (A)	1.30 ± 0.07	9.23 ± 0.45	0.39 ± 0.02	0.31 ± 0.02
SF x RO (B)	1.27 ± 0.06	9.25 ± 0.43	0.43 ± 0.02	0.33 ± 0.02
Sex	**n.s.**	**n.s.**	*****	**n.s.**
Males (A)	1.33 ± 0.05	9.37 ± 0.36	0.43 ± 0.01 ^{b}	0.33 ± 0.02
Females (B)	1.24 ± 0.08	9.11 ± 0.51	0.38 ± 0.02 ^{a}	0.31 ± 0.03
Litter size	**n.s.**	*****	******	******
Singles (A)	1.49 ± 0.13 ^{b}	9.16 ± 0.87	0.33 ± 0.03 ^{bCd}	0.22 ± 0.05 ^{D}
Twins (B)	1.12 ± 0.07 ^{a}	8.58 ± 0.51 ^{c}	0.41 ± 0.02 ^{a}	0.32 ± 0.03 ^{d}
Triples (C)	1.30 ± 0.07	10.25 ± 0.46 ^{b}	0.45 ± 0.02 ^{A}	0.32 ± 0.02 ^{D}
Quadruplets (D)	1.22 ± 0.09	8.97 ± 0.61	0.44 ± 0.02 ^{a}	0.43 ± 0.03 ^{AbC}

n.s. = nonsignificantly different; *, a, b, c, d = P ≤ 0,05, * *, A, B, C, D = P ≤ 0,01

CONCLUSIONS

The genotype and the sex had not a significant effect on daily gain of lambs in the period from birth till the slaughter. On the other hand the litter size had a highly significant effect on daily gain in above-mentioned period, whilst the highest daily gain was found in singles. Concerning the carcass traits the genotype had a significant effect only on dressing percentage whereas the sex had a significant effect only on proportion of kidney. By contrast the litter size had a significant effect on dressing percentage and proportions of skin, kidney and kidney fat. In conclusion it can be completed that the fatness scores of all individual carcasses were relatively low which is important for the consumers who prefer lean lamb meat. The low fatness of the carcasses also leads to better realisation of the carcasses on the market. The meat colour in all groups was also relatively very favorable whereas in all individual carcasses was not found worse colour class than pink.

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