The effect of genotype on the behaviour of free range chickens

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Abstract

The purpose of this experiment was to investigate the behaviour of fast- and slow growing chickens, when the birds had access to the outdoors. Fifty of both 1-day-old male chicks of a laying hybrid ISA BROWN (IB) and broilers ROSS 308 (RS) were kept in two pens in the same building. In each group ten birds were marked with a colored spray. From three weeks of age the birds had access to the outdoors. From the age of one to seven weeks old, one day a week the marked birds were observed from 8:00 to 18:00 every ten minutes and the activity was noted. At 49 and 90 days old twenty birds were slaughtered and the strength of bones was measured. The behaviour was expressed as percentage of the time spent in activity. The average time that the birds spent eating during the 7 week period was almost the same in IB and RS. On average, IB birds spent significantly higher ($P<0.05$) an amount of time moving around, but until the fifth week of age there was no significant difference between these genotypes. In IB, movement was the more frequent activity. The resting sitting down was the most frequent activity in RS and since three weeks of age they spent significantly more ($P<0.05$) time with this activity than IB. On average, the IB birds spent significantly more ($P<0.05$) time scratching than did the RS. No aggression or pecking was observed in the IB males during the whole test period. The strength of the femur was significantly higher in RS in comparison with IB in both ages (49d - $P<0.001$, 90d - $P<0.05$). Although the rules for organic farming dictate that the chickens have to have enough outdoor area to move around in, the fast growing broilers do not use it.

Keywords: behavior, broiler, free range, laying hybrid, male

Introduction

Freedom to express normal behaviour is one of the so-called Five Freedoms; Freedom from hunger and thirst, Freedom form thermal and physical discomfort, Freedom form pain, injury and disease, Freedom to express normal behaviour and Freedom from fear and distress (Spoolder, 2007). These freedoms should promote and ensure farm animal welfare. Anyway the normal behaviour of birds and animals can be changed by intensive breeding. According to the resource allocation theory broilers behaviour is modified toward less energetically costly behaviour suggesting that energy demanding behaviour decreases in frequency when selection pressure for other demanding traits increases (fast growth) (Beilharz et al., 1993 cited in Lindqvist et al., 2006, p.162). Lindqvist et al. (2006) propose that broilers have a reduced need to search for food and that they have the need to save energy which could be reallocated to growth. A lot of authors compared the behaviour of fast and slow growing male broilers or layer hybrids (Bizeray et al., 2000; Bokkers and Koene, 2003; Gerken et al., 2003; Bokkers and Koene, 2004; Lindqvist et. al, 2006). However all of these studies compared the behaviour of the birds which had no access to the outdoors. There are few experiments which have compared the behaviour of these two different genotypes when they are being raised in the extensive housing system (organic, free range). Zupan et al. (2005) compared the behaviour of the birds in three different housing systems, but he used only broilers in these studies.

In the EU, the consumption of organic products or products from free range operations is increasing. The consumers are also more interested in the animal's welfare. Mainly organic farming is well able to provide conditions which promote good animal welfare because this system more or less complies with the Five Freedoms (Spoolder, 2007). Mostly special hybrids are used for organic poultry production, but there are also countries where these hybrids are not available. In this case farmers can use for this system broilers or layer males. As the behaviour of fast growing broilers has changed under intensive management conditions (Bessei, 1992), the question is whether or not the broilers will be able to utilize and benefit from the conditions used in organic farming. The age of chickens at slaughter differs depending on country, anyway fast growing broilers are generally slaughtered at age from 35 to 42 day, free range chickens form 56 to 81 days of age and organic chicken generally at least at 81 days.

The purpose of this experiment was to investigate the behaviour of fast- and slow growing chickens (male Ross 308 broiler vs male Isa Brown laying hybrid) from hatch to seven weeks of age and then briefly at ten and thirteen weeks, when the birds had access to the outdoors. The hypothesis was that fast- and slow growing broilers would act the same behaviourally, but with different time spell and that increasing age would increase this difference in the spells. The second hypothesis was that fast growing broilers would have poorer quality of the leg bones because of faster growth and supposed less activity.

Materials and methods

Animal and housing

Fifty 1-day-old male chicks of a laying hybrid ISA BROWN (IB) and fifty 1-day-old male chicks of ROSS 308 (RS) were kept in two pens in the same building. The floor was covered with wood shavings, which were regularly added. The concentration was 6 birds per square meter. In each group ten birds were marked on their back with a colored spray.

For the first 15 days, the birds were fed a starter (22.9% crude protein and 11.1 $MJ*kg^{-1}$ ME), then, they were fed a grower till 44 days (18.7% crude protein and 11.7 $MJ*kg^{-1}$ ME) and then a finisher until they were 91 days old (16.6% crude protein and 11.3 $MJ*kg^{-1}$ ME). Artificial light was provided initially at a rate of 23-h light and 1-h dark. After one week, the schedule was changed to 16-h light and 8-h dark was provided. Light intensity was 20 lx at animal zone, and incandescent bulbs were used as source of light. The experiment took place from August to November and from the third week of age, a combination of daylight plus artificial light was used to allow 16h of light. The temperature was maintained at 30 ^{o}C at the beginning of the experimental period and was gradually decreased to 20 ^{o}C at the fourth week of age, after which natural temperature was used. The birds had free access to feed and water at all times (both outside and inside).

From three weeks of age the birds had access to the outdoors in a space of 325 square meters for each group (6.5 square meters per cockerels).

Behavioural observations

From the age of one to seven weeks old, one day a week the marked birds were observed from 8:00 to 18:00. Every ten minutes, it means in ten minute intervals, the activity of the ten marked birds was noted in each group. Each day in each group 600 notations were made. Since the third week of age the activity of the birds was noted both in the pens and in the outdoor areas. At 10 and 13 weeks of age, the observations occurred only from 8:00 to 9:00 and from 11:00 to 12:00 and during these days 120 notations were made in each group.

Recorded behaviours were as follows:

Eating – feeding from the feeders inside or in the outside pen

Drinking – drinking from drinkers inside or outside in the pen

Movement – walking, running, flying

Resting – standing – standing without any other activity

Resting – sitting – sitting without any other activity

Dust bathing

Scratching

Comfortable behaviour – preening, stretching of wings and/or legs

Aggression – pecking at other birds

Pecking – repeating pecking on anything (except another bird).

The occurrence of each activity during each day was calculated as a percentage of the recorded information of each particular activity from 600 (total number of notations = 100%).

Bone quality

At 49 and 90 days of age ten birds were slaughtered in each group and the length and width of tibias and the femurs were measured by sliding scale with accuracy 0.05 mm. Length was measured between proximal and distal epiphysis and width was measured in the middle of the bones, then they were put into plastic bags. The same day the strength of the bones was measured by the universal instrument for measuring physical characteristics TIRATEST 27 025 (TIRA GmbH, SRN). The bones were put under stress at the speed of 20 $mm*min^{-1}$ until they broke. The force was administered in the centre of the bones, plumb on the long axis. Also the length and width in the centre of the bones was measured.

Statistical analysis

Behavioural data were analyzed by the test of hypothesis for two samples represent independent binomal experiments (McClave and Benson, 1988). The quality of the bones (strength, length, width) was analyzed by the nonparametric Mann-Whitney U-Test using the software package Unistat 5.1 (UNISTAT Ltd, ENGLAND).

Results

The behaviour of the IB and RS birds which was expressed as a percentage of the time spent in activity between the time of 8:00 to 18:00 over a seven week period is shown in Table 1. Table 2 shows the percentage of the main activities outside and inside the building. Table 3 shows the behaviour as a percentage during shortened periods of observation: 8:00 – 9:00 and 11:00 – 12:00 at 10 and 13 week of age. Figure 1 shows the behaviour as an average percentage during the first seven weeks.

Table 1. Proportion of time spend by different activity from 8:00 to 18:00

Week of age	1*		2*		3		4		5		6		7	
Behaviour (%)	IB	RS	IB	RS	IB	RS	IB	RS	IB	RS	IB	RS	IB	RS
Eating	23.4	30.4	21	30.2	5.5	4.5	19	14.8	28.8	24.6	26.3	24.6	25.9	29
Drinking	2.8	4	7.8	4	6	2	3.6	2.6	2.8	3	1.7	2.3	1.3	3
Movement	20.6	17.3	29.8	19.1	34	37	44.1	31.4	39.4^{b}	18.5^{a}	28.7^{b}	15.3^{a}	19.1^{b}	7.3^{a}
Standing	0.9	1.8	0.3	0.7	0	0	0.5	0.8	0.3	1.4	0	0.3	0	1.2
Sitting	35.5	32.2	21.3	31.9	19^{a}	48^{b}	21^{a}	44^{b}	21.5^{a}	43.8^{b}	38.1^{a}	55.6^{b}	46.1	50.8
Dust bathing	0.4	1.3	0.1	1.8	0	0	0.3	0.3	0	0.5	0.7	0	0	0.1
Scratching	11.7	6	11.3^{b}	3^{a}	33^{b}	7^{a}	6.2	2.2	3	2	1.2	0.3	3	1.1
Comfortable	4.7	5.9	8.4	9.3	2.5	1.5	5.3	3.6	4.2	5.8	3.4	1.6	4.6	7.1
Aggression	0	0.3	0	0	0	0	0	0.1	0	0.1	0	0	0	0.3
Pecking	0	0.8	0	0	0	0	0	0.2	0	0.3	0	0	0	0.1

* First and second week of age without access to the outdoor.

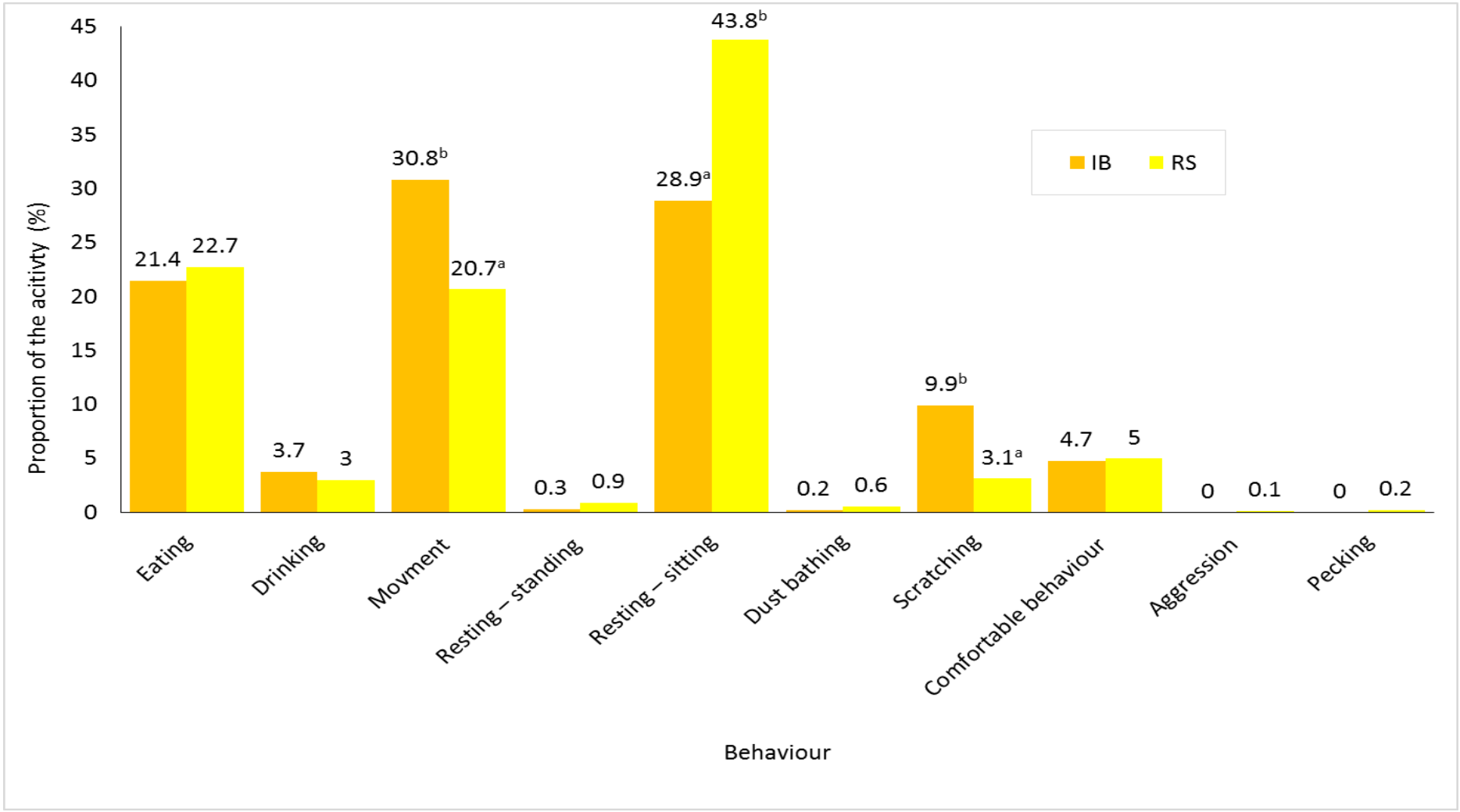
IB – ISA Brown, RS – Ross 308

$^{a, b}$ $P<0.05$

Table 2. Behaviour as percentage proportion of particular activity during 8:00 – 18:00 outdoor or inside

Week of age		3		4		5		6		7	
Behaviour (%)		IB	RS	IB	RS	IB	RS	IB	RS	IB	RS
Eating	IN	45.5	55.6	31.6	7.9	24.1	6.4	34.8	3.7	30.6	4
	OUT	54.5	44.4	68.4	92.1	75.9	93.6	65.2	96.3	69.4	96
Movement	IN	39.7	27	37.8	23.9	33.4	5.9	20.6	11.9	21.1	6.8
	OUT	60.3	73	62.2	76.1	66.6	94.1	79.4	88.1	78.9	93.2
Resting – sitting	IN	100	93.8	94.9	74.6	94.6	50.8	95.6	24.3	80.4	40.2
	OUT	0	6.2	5.1	25.4	5.4	49.2	4.4	75.7	19.6	59.8

IB – ISA Brown, RS – Ross 308



a, b P<0.05

Figure 1. Behaviour as average percentage over the first 7 weeks of age

Table 3. Activities during 8:00 – 9:00 and 11:00 – 12:00

Week of age	10		13	
Behaviour (%)	IB	RS	IB	RS
Eating	22.5[b]	5[a]	12[b]	0[a]
Drinking	5	7.5	0	0
Movement	42.5	37.5	35[b]	12.5[a]
Resting – standing	0	0	0	0.5
Resting – sitting	27.5[a]	47.5[b]	40.5[a]	85[b]
Dust bathing	0	0	0	0
Scratching	0	0	0	0
Comfortable behaviour	2.5	2.5	12.5[a]	2.5[b]
Aggression	0	0	0	0
Pecking	0	0	0	0

* First and second week of age without access to the outdoor.

[a, b] $P<0.05$

IB – ISA Brown, RS – Ross 308

Eating

The average time that the birds spent eating during the 7 week period was almost the same in IB and RS (Figure 1). The behaviour expressed as a percentage of the time spent in the activity from 8:00 to 18:00 during each week is shown in Table 1. During the first two weeks the broilers RS spent more time by eating than the IB males, but after allowing the access to the outdoors, the IB birds spent more time eating than RS (exception during week 7, Table 2). At the observation times during weeks 10 and 13 (8:00 – 9:00 and 11:00 – 12:00 Table 3) IB spent significantly more time eating than RS ($P<0.05$). During the first week of access to the outdoors (three weeks of age) the birds consumed their feed both inside and outside almost in the same proportion (Table 2) but then they preferred to eat outside. IB consumed feed more often inside than RS. The proportion of time spent eating decreased at three weeks of age due to access to the outdoors, in both in IB and RS groups of birds.

Drinking

On average, there was almost the same amount of time spent drinking. During the second, third and fourth weeks of age the IB spent more time drinking than RS birds (Table 1). The proportion of time spent drinking was almost the same depending upon the age of the birds in both IB and RS.

Movement

On average, the IB birds spent an amount of time moving around which was significantly higher ($P<0.05$) than in RS (Table 1). Until the fifth week of age there was no significant difference between these two genotypes. In both RS and IB more movement was observed outside, but IB had more of this activity inside than RS (Table 2). The peak of this behaviour was observed during the third week of age in RS and during the fourth week of age in IB. After this peak the percentage of movement rapidly decreased. In IB, movement was the more frequent activity. During the day the peak of movement was from 8:00 to 9:00 in both genotypes (IB 46.2%, RS 33.7%).

Resting – standing, sitting

The birds spent a minimum amount of time resting standing up (Table 1). Anyway resting sitting down was the most frequent activity in RS and since three weeks of age they spent significantly more ($P<0.05$) time with this activity than IB (except during the first, second and seventh week). The time spent resting-sitting increased in the IB at six weeks of age. Until this age (except during the first week), the proportion of resting was almost the same during each week in IB. In RS the proportion of this activity was very high from three weeks of age. The IB birds rested mainly inside during all 7 weeks (each week more than 80% of total resting time). RS rested during the third and fourth week mainly inside, and at five weeks of age the percentage was almost the same (50.8% IN, 49.2% OUT, Table 2). Than a higher percentage of these birds rested outside. During the day the peak of resting – sitting time was from 14:00 to 15:00 in both genotypes (IB 42.4%, RS 51.2%).

Dust bathing

The dust bathing was minimal in both genotypes (Table 1). The highest percentage of this activity was observed in the RS birds during the first and second weeks of age (1.3 and 1.8%).

Scratching

On average, the IB birds spent more time scratching than did the RS birds (Table 1), at the second and third weeks of age the differences were significant ($P<0.05$). In both genotypes the peak of scratching was observed during the third week of age after they had access to the outdoors.

Comfortable behaviour

There was no significant difference in comfortable behaviour between IB and RS over seven weeks (Table 1). The peak of this behaviour was observed in both genotypes during the second week of age.

Aggression and pecking

No aggression or pecking was observed in the IB males during the whole test period, and in the RS birds these two kinds of behaviour were also minimal (Table 1).

In the shortened observation at 10 and 13 weeks of age there was not observed any aggression neither pecking (Table 3).

Bone quality

The average live body weight was at 49d 721 g in IB and 2,243 g in RS, and 1,769 g in IB and 5,408 g in RS at 90d. At the end of the experiment, 13 weeks of age, the weight was 1,828 g (IB) and 5,489 g (RS).

The bone quality is shown in Table 4. The strength of the femur was significantly higher in RS in comparison with IB in both ages (49d - $P<0.001$, 90d - $P<0.05$). The strength of tibia was also significantly higher in RS ($P<0.001$) at both ages. Length of the femur and tibia was longer ($P<0.001$) in RS at 49 days old. At 90 days old, only the femur was significantly longer ($P<0.05$) in RS. The same was observed in the width of femur. At age 49d, the width of the femur and tibia was significantly larger than in RS ($P<0.001$). At 90 days of age, the only significant difference between the RS and the IB birds was the width of the femur ($P<0.001$).

Table 4. Bone quality of broilers and laying males

Bones quality	Age	IB			RS			P-value
		Mean	±	SE	Mean	±	SE	
Strength of femur (N)	49d	216.5	±	8.02	359.8	±	12.2	<0.001
	90d	321.9	±	19.14	457.9	±	44.9	<0.05
Strength of tibia (N)	49d	150	±	10.12	336.8	±	20.2	<0.001
	90d	286.2	±	23.2	480.5	±	37	<0.001
Length of femur (cm)	49d	6.6	±	0.09	8.1	±	0.15	<0.001
	90d	9	±	0.07	9.8	±	0.29	<0.05
Length of tibia (cm)	49d	9.1	±	0.09	11.1	±	0.18	<0.001
	90d	13.3	±	0.09	13.9	±	0.35	>0.05
Width of femur (cm)	49d	0.7	±	0.02	1.2	±	0.09	<0.001
	90d	0.9	±	0.02	1.1	±	0.04	<0.001
Width of tibia (cm)	49d	0.9	±	0.03	1.4	±	0.07	<0.001
	90d	1	±	0.02	1.1	±	0.04	>0.05

IB – ISA Brown, RS – Ross 308

Discussion

The purpose of this experiment was to investigate the behaviour in fast- (RS) and slow- (IB) growing birds which had access to the outdoors over a five week period from 8:00 – 18:00 and also during a shortened period of time during weeks 10 and 13.

Both genotypes spent the most time resting-sitting, moving and eating. The fast growing broilers (ROSS 308) rested (sitting) significantly more ($P<0.05$, except for 7th week of age) than the slow growing birds (ISA BROWN males) since the time when they were three weeks old. Lindqvist et al. (2006) also observed significantly ($P<0.001$) more inactive behaviour in the broilers in comparison with the layers. Contrary to this finding, Bokkers and Koene (2003) did not find a difference between the fast and the slow growing broilers, but their birds did not have access to the outdoors and they used a different slower growing genotype (slow growing broilers JA 657) in their experiment. The fast growing broilers rested 43.8% of the total observed time during the first seven weeks, which is a little lower in comparison to

the observations of fast growing broilers (57%) of Bokkers and Koene (2003). This is probably due to the outdoor access. This result is confirmed also by Zupan et al. (2005) who indicated that the behaviours of the broilers kept in an intensive farming system are more passive than those of the free range and organic birds. Bessei (1992) reported that the length of resting time was about 80 to 90% in broilers under intensive management. In this experiment such a high percentage of resting time was observed only when the birds were 13 weeks of age, when the proportion went from 32 to 56%.

Until the third week of age (till 15 days), there wasn't a significant difference between IB and RS in resting-sitting activity, which does not support the resource allocation theory of Beilharz et al. (1993 cited in Lindqvist et al., 2006, p. 162). The theory of Bokkers and Koene (2004) that physical ability is the dominant determinative factor for walking in birds with a high body weight is more likely because since the third week of age the difference between the body weight of Ross 308 and Isa Brown increased significantly. Quantitatively, but not qualitatively, restricting the food can improve the activity level of the broilers (Nielsen et al., 2003). But than the first Freedom from hunger requirement is not met.

The time spent moving around was significantly higher in IB (30.8%) than in RS (20.7%) over the 7 week period. This is a higher percentage than the other authors found (11% and 5% Bokkers and Koene, 2003). Gerken et al. (2003) also reported higher locomotor activity by the layer strains than by the broilers. This physical activity decreased in RS after three weeks of age (37%). The peak of activity at this time was probably because the birds had free access to the outdoors. Bokkers and Koene (2003) observed a decrease of walking in fast growing broilers from the first week of age. They noted that the peak of walking in slow growing broilers occurred at five weeks of age. In the experiment, however, this peak was noted one week earlier in the IB group. The heavier body weight could be the reason why the fast growing broilers reduced their movement Bokkers and Koene (2004).

Although the litter was of very good quality low interest in dust bathing was found (IB 0.2% and RS 0.6%) which is lower than Bokkers and Koene (2003) found (2-3%). These findings, however, were in agreement with those of Bessei (1992). In his experiment, litter scratching and dust bathing occurred infrequently during the first three weeks of age, and the same trend was observed in this experiment in both broilers and layers. The significantly higher ($P<0.05$) scratching activity of layers agrees with the findings of Lindqvist et al. (2006).

Some authors found that the eating behaviour differs among genetic lines of birds which were selected for body weight (Masic et al., 1974; Bokkers and Koene, 2003) but this was not confirmed in this experiment (21.4% IB and 22.7% RS). Significant decrease of eating was found only in the third week of age because that was the first week that the birds had access to the outdoors. Bokkers and Koene (2003) found that the decrease in eating habits depended on age of the broilers. Feed intake culminates in the morning and in the evening due to natural day-night cycles (Bessei, 1992) and it was confirmed in this experiment.

There was no difference between genotypes in the time spent drinking, but Lindqvist et al. (2006) observed that the broilers spent a significantly ($P<0.001$) higher time

drinking than did the layers. The access to the outdoors had not any effect on aggression or pecking behaviour.

There was no problem with locomotion in either the broilers or the layer males. The quality (strength) of bones was higher in the broiler than it was in the layer males. The good quality of bones in the broilers could be the result of lower stock density as well as more freedom of movement allowed by access to the outside (Bizeray et al., 2004; Reiter, 2006).

Conclusion

The main differences between male Ross 308 broiler and male Isa Brown laying hybrid were found in resting-sitting, moving and scratching. These behaviours were affected by the age of the birds and probably also by their weight. The live body weight at thirteen weeks of age was 1,828 g in Isa Brown and 5,408 g in Ross 308. Slow growing birds preferred resting and eating inside. Fast growing broilers preferred eating outside. The reason for the lower movement and higher resting of broilers could be the live weight and probably the body conformation (centre of gravidity), because the strength of both femur and tibia was higher in the fast growing broilers. Although the rules for organic farming dictate that the chickens have to have enough outdoor area to move around in, the fast growing broilers do not use it.

Acknowledgements

The authors would like to thank Mrs. Judy McPherson for the language correction. The results were obtained with financial support by the project of MENDELU, Faculty of AgriSciences IGA No. TP 7/2017: Analysis of performance and behaviour of farm animals in relation to ambient temperature variability and possibilities of elimination of its impact.

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