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Growth performance and organoleptic properties of broilers raised on used and mixed litters

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Abstract

An investigation comprising of three experiments were conducted to study the effect of different litter types on growth performance and organoleptic properties of broilers. Each experiment of 6 weeks duration was conducted with 270 numbers of chicks divided equally into three litter type made of paddy husk in three replicates, each of 30 birds. The litter types were fresh (control), used (once-used (UL-I), twice-used (UL-II) and thrice –used (UL-III) and mixed (50 parts of fresh litter mixed with 50 parts of once-used litter (ML-I), twice-used litter (ML-II) and thrice-used litter (ML-III). Fresh litter (control), used litter (once -, twice- and thrice- used) and mixed litter (50 parts of fresh litter and 50 parts of once-, twice- and thrice-used) were used. Average body weight, feed conversion ratio, survivability rate and dressing percentage of broilers reared on the three different types of litters were recorded. There were no significant ($P<0.05$) difference in tenderness, juiciness, flavour and overall acceptability of broilers raised in Experiments I and II. In Experiment III, the broiler raised on used and mixed litter groups were found to be significantly ($P<0.05$ to 0.01) better in tenderness and juiciness qualities than those raised on fresh litter. The results suggest a possible relationship between the types of the litter used for reared of broiler with organoleptic properties of meat.

Keywords: Broiler, litters, growth performance, organoleptic properties, feed conversion ratio

Introduction

Poultry is one of the most rapidly escalating segments of the agricultural sector in India. In last 40 years poultry industry has changed itself from backyard to a scientific industry. Our country has ranked 5th on the global poultry meat production with peak production reaching 5100 metric tons [6]. As per vision 2030 of CARI, Izatnagar the annual growth rate for egg and meat production in India shall be 6% and 10%, respectively. The capacity of poultry sector in employment creation and increasing rural income is well known. Apart from the several small poultry farmers, Indian poultry industry gives employment (directly or indirectly) to more than 5 million persons. Poultry is also an efficient converter of animal feed into animal protein of high biological value compared to other livestock. The usual practice in broiler production is to use fresh litter for a new flock. But due to non-availability of quality litter materials at a reasonable price, many farmers prefer to raise consecutive batches of broilers on the same litter for economic reasons. However, the practice of using used litter is not always free from problems as there is possibility of breakdown of flock health from disease causing agents carried over for the previous flocks. Available literature reveals that not much work has been done in India on growth performance of broilers raised on used litters and also on the organoleptic properties of broiler meat. An investigation was undertaken to study the effect of used (once-, twice and thriceused) and mixed litters (50 parts of fresh litter and 50 parts of once-, twice- and thrice-used litter) on the growth performance and organoleptic properties of broiler meat.

Materials and Methods

The investigation comprise of three consecutive Experiments (Experiment I, II and III) involving a total of 810 commercial hybrid broiler chicks. Each experiment of 6 weeks duration was conducted with 270 numbers of chicks divided equally into three litter type made of paddy husk in three replicates, each of 30 birds. The litter types were fresh (control), used (once-used (UL-I), twice-used (UL-II) and thrice –used (UL-III) and mixed (50 parts of fresh litter mixed with 50 parts of once-used litter (ML-I), twice-used litter (ML-II) and thrice-used litter (ML-III) (Table 1). Standard managerial practices were followed to raise the broilers

up to 6 weeks of age. The performance of the broilers in respect to their body weight, feed conversion ratio (FCR) and percent survivability were recorded for each group in all the three experiments. At the end of each experiment, two broilers (one male and one male) from each replicate of a litter type that is 6 birds from each litter types were randomly selected to record the carcass characteristics and evaluate the organoleptic properties. To assess the organoleptic characteristics, a test panel was constituted with 9 habitual

meat eaters of heterogeneous age group (25-55 years). Breast meat cut into small and uniform pieces and cook at 10 lb pressure for 5 minutes were serve to the panel members to assess tenderness, juiciness, flavour and overall acceptability of the samples by using a 9-point Hedonic scale, 1 being the lowest and 9 being the highest score ^[2]. The average score awarded by the members were used for interpretation. The data of the experiment were analysed statistically by following a standard procedure ^[3].

Table 1: Allotments of chicks to litter types

Experiment No.	Litter type	No. of Chicks	No of chicks per experiment
Ex-I	Fresh litter (FL-I)	90	270
	Once-used litter (UL-I)	90	
	Mixed litter (ML-I)	90	
Ex-II	Fresh litter (FL-II)	90	270
	Twice-used litter (UL-II)	90	
	Mixed litter (ML-II)	90	
Ex- III	Fresh litter (FL-III)	90	270

Results and Declarations

The average body weight, feed conversion ratio, percent survivability and dress weight of broilers at 6 weeks of age raised on fresh, used and mixed type of litters in three consecutive experiments are presented in Table 2. The average body weight at 6 weeks of age was 1950.06±25.64, 1961.57±27.11 and 2015.47±23.16g for the broilers raised on fresh (FL-I), used (UL-I) and mixed type of litter (ML-I), respectively in experiment 1. In case of the broilers raised in experiment II, the body weight of fresh (FL-II), used (UL-II) and mixed type of litters (ML-II) at similar age were 1963.03±21.51, 1988.56±17.91 and 1970.90±17.53g, respectively. The corresponding values for fresh (FL-III) used (UL-III) and mixed type of litters (ML-III) in experiment III were 1913.64±19.74, 1965.46±19.62 and 2010.48±20.46 g, respectively. It was observed that the average body weight of broilers on the three different types of litters (fresh, used and mixed) both in experiment I and experiment II were non-significant statistically, although marginal difference in favour of the broilers raised on used (UL-I and UL-II) and mixed type of litters (ML-I and ML-II) were noticed. The reasons for the beneficial effects of using used litters or mixed litters might be due to synthesis of certain vitamin B-complexes in used litters due to microbiological activity ^[4, 5, 6]. Used litter possesses less of hazard to health because its chemical composition has a stabilising effect on the microbiological population ^[7]. Certain unidentified growth factors might play a role in promoting growth ^[8] and presence of some microorganisms in the used litter might act as probiotic for broilers raised on it. These factors may possibly act as accelerating the metabolism for growth in chicks raised on used litters. Earlier workers ^[9, 10, 11, 12] also advocated raising chicks on used litters to promote growth, similar to the findings of the present investigation. On the contrary, of present findings neither beneficial nor harmful effects of used litters on the growth of broilers ^[13, 14, 15, 16, 17, 18, 19, 20]. In experiment III, broilers raised on mixed litters (ML-III) had significantly ($P<0.05$) better body weight at 6 weeks of age than the contemporary broilers raised on fresh litter (FL-III). However, there was no significant difference between the average body weight of the broilers raised on fresh (FL-III) and used litters (UL-III) as well as between used (UL-III) and mixed type (ML-III) of litter. Since the mixed type of litters was prepared by mixing 50 parts of used litters with 50 parts

of fresh litter, it may be assumed that broilers grown on mixed type of litters might have received benefits from the both the types of litters. These may be the reason for obtaining apparently better growth in mixed litter grown broilers in experiment I and II and significantly ($P<0.01$) better growth (2010.48±20.46g) in Experiment III as compared to that of broilers raised on fresh litters (1913.64±19.74g) at 6 weeks of age. The average FCR of broilers raised on FL-I, UL-I and ML-I at 6 weeks of age in Experiment I were 2.003±0.02, 2.025±0.02 and 1.967±0.02, respectively. The corresponding FCR in Experiment II were 2.049±0.02, 2.013±0.02 and 1.994±0.02 and in experiment III FCR of 2.069±0.03, 2.051±0.03 and 2.094±0.08, respectively were recorded. There was also no significant ($P>0.05$) difference in the average FCR of broilers up to 6 weeks of age among the 3 litter types in all the 3 experiments. The average survivability of broilers up to 6 weeks of age raised on FL-I, UL-I and ML-I type of litter in Experiment I were 95.56±1.1, 96.67±0.02 and 95.56±1.11 percent, respectively. The corresponding values in Experiment II were 98.89±1.11, 100.00±0.00 and 98.89±1.11 while in Experiment III average survivability of 97.78±1.11, 94.45±1.11 and 92.23±2.94, per cent, respectively were recorded. The survivability percent of broilers at 6 weeks of age raised on 3 litter types in all the 3 experiments were statistically non-significant. The percent dressed weight of broilers slaughtered at 6 weeks of age in Experiment I were 74.09±0.23, 73.76±0.21 and 73.70±0.23, respectively for FL-I, UL-I and ML-I. In experiment II, the values were 73.60±0.24, 74.08±0.23 and 73.91±0.31 and in Experiment III the corresponding figures were 72.94±0.34, 73.03±0.57 and 73.96±0.18, respectively. The dressed weight percentage also revealed no significant difference among the broilers raised on fresh, used and mixed type of litter in all the 3 experiments. These findings suggest that broilers can be raised successfully on once, twice- and thrice- used litters either as such or mixed with 50 parts of fresh litter without any detrimental effect on their average body weight, FCR, survivability and dressing percentage. The average score for the organoleptic properties (tenderness, juiciness, flavour and overall acceptability) of broiler meat raised on fresh, used and mixed type of litter in the 3 experiments are presented in Table 3. The analysis of variance for tenderness, juiciness, flavour and overall acceptability of meat of broilers raised on fresh, used and mixed type of litters Experiment I, II and III

are presented in Table 3. In Experiment I, the average tenderness, juiciness, flavour and overall acceptability of broiler meat, irrespective of sex raised on FL-I were 6.77 ± 0.18 , 6.42 ± 0.18 , 6.20 ± 0.20 and 6.41 ± 0.19 , respectively. The corresponding scores in UL-I were 6.52 ± 0.19 , 6.20 ± 0.20 , 6.05 ± 0.21 and 6.24 ± 0.20 and in ML-I mean score of 6.51 ± 0.21 , 6.28 ± 0.20 , 6.03 ± 0.22 and 6.22 ± 0.19 , respectively were recorded. The analysis of variance of the data of Experiment I (Table 4) revealed that the effect of litter, sex and sex x litter were not significant ($P > 0.05$) for all the organoleptic properties although apparent differences existed amongst them. In Experiment II, the average tenderness, juiciness, flavour and overall acceptability of broiler meat, irrespective of sex, raised on FL-II were 6.74 ± 0.15 , 6.76 ± 0.11 , 6.85 ± 0.11 and 6.88 ± 0.12 , respectively. The corresponding scores in UL-II were 6.90 ± 0.16 , 6.88 ± 0.14 , 6.97 ± 0.10 and 7.00 ± 0.12 while average score of 6.88 ± 0.18 , 6.85 ± 0.15 , 6.88 ± 0.14 and 6.93 ± 0.14 , respectively were recorded in ML-II. The analysis of variance revealed that the effect of litter, sex, and sex x litter were non-significant ($P > 0.05$) for the organoleptic properties even though marginal differences amongst them could be observed. The results of both the experiments indicated that the types of litters used in Experiment I (FL-I, UL-I and ML-I) and II (FL-II, UL-II and ML-II) had similar influence on the tenderness, juiciness, flavour and overall acceptability of broiler meat. This suggests that broilers can be raised on once- and twice-used litters of paddy husk either as such or mixed with 50 parts of fresh litter without any adverse effect on organoleptic properties of the meat quality. In Experiment III, the average tenderness, juiciness, flavour and overall acceptability score of broiler meat, irrespective of sex, raised on FL-III were 6.28 ± 0.14 , 6.35 ± 0.11 , 6.29 ± 0.10 and 6.46 ± 0.09 , respectively. The corresponding figures in UL-III group 6.88 ± 0.17 , 6.83 ± 0.16 , 6.57 ± 0.12 and 6.75 ± 0.14 and while in ML-III group, average scores of 6.92 ± 0.16 , 6.88 ± 0.15 , 6.57 ± 0.15 and 6.81 ± 0.15 , respectively were recorded. The analysis of variance of the data revealed that the effect of litter on tenderness and juiciness were highly significant ($P < 0.01$),

while the effect of sex and sex x litter were non-significant ($P > 0.05$). The CD test revealed that the average tenderness (combined sex) of UL-III and ML-III were significantly higher ($p < 0.01$) than that of FL-III. Similarly, the average juiciness (combined sex) of UL-III and ML-III were also significantly higher ($P < 0.01$) than that of FL-II. However, tenderness and juiciness (combined sex) of UL-III and ML-III did not differ significantly. Significantly higher ($P < 0.01$) tenderness and juiciness of broiler meat raised on UL-III and ML-III as compared to that of FL-III in Experiment III might be due to the used of thrice-used litter which were used either as such (UL-III) and mixed with 50 parts of fresh litter (ML-III). This suggests a possible relationship between the numbers of broods raised on a litter with the organoleptic qualities of broiler meat. The results of 't' test (Table 4) revealed that broilers raised on UL-II had significantly ($P < 0.01$) better juiciness, flavour and overall acceptability of meat as compared to broilers raised on UL-I but the tenderness was only apparently better in UL-II as compared to UL-I. Similarly, UL-III group had significantly ($P < 0.05$) better juiciness, flavour and overall acceptability as compared to that of UL-I while, the tenderness was only apparently better in UL-III. On comparison of the organoleptic properties of broilers raised on UL-II and UL-III, the flavour quality of meat of UL-II was found to be significantly better ($P < 0.05$) than that of UL-III, while there were no significant differences in tenderness, juiciness and overall acceptability of meat between these two groups. The results of 't' test (Table 6) revealed that broilers raised on ML-II had significantly ($P < 0.05$ to 0.01) better juiciness, flavour and overall acceptability as compared to that of ML-I while, tenderness was slightly in ML-II as compared to ML-I group. Similarly, meat of ML-III group was significantly ($P < 0.05$) better in terms of juiciness, flavour, overall acceptability and tenderness as compared to that of ML-I. However, there were no significant ($P > 0.05$) difference in tenderness, juiciness, flavour and overall acceptability of meat between ML-II and ML-III groups.

Table 2: Effects of litter types on body weight, feed conversion ratio, survivability (%) and dressed weight of broilers at 6 weeks of age (Mean \pm SE)

Experiment	Litter type	Body weight (g)	FCR	Survivability (%)	Dressed weight (%)
Ex-I	FL-I	1950.06 ^a \pm 25.64	2.003 ^a \pm 0.02	95.56 ^a \pm 1.11	74.09 ^a \pm 0.23
	UL-I	1961.57 ^a \pm 27.11	2.025 ^a \pm 0.02	96.67 ^a \pm 0.02	73.76 ^a \pm 0.21
	ML-I	2015.47 ^a \pm 23.16	1.967 ^a \pm 0.02	95.56 ^a \pm 1.11	73.70 ^a \pm 0.23
Ex-II	FL-II	1963.03 ^a \pm 21.51	2.049 ^a \pm 0.02	98.89 ^a \pm 1.11	73.60 ^a \pm 0.24
	UL-II	1988.56 ^a \pm 17.91	2.013 ^a \pm 0.02	100.00 ^a \pm 0.00	74.08 ^a \pm 0.23
	ML-II	1970.90 ^a \pm 17.53	1.994 ^a \pm 0.02	98.89 ^a \pm 1.11	73.91 ^a \pm 0.31
Ex-III	FL-III	1913.64 ^a \pm 19.74	2.069 ^a \pm 0.03	97.78 ^a \pm 1.11	72.94 ^a \pm 0.34
	UL-III	1965.46 ^a \pm 19.62	2.051 ^a \pm 0.03	94.45 ^a \pm 1.11	73.03 ^a \pm 0.57
	ML-III	2010.48 ^b \pm 20.46	2.094 ^a \pm 0.03	92.23 ^a \pm 2.94	73.96 ^a \pm 0.18

Figures in a column within an experiment with at least one superscript in common do not differ significantly ($P < 0.05$)

Table 3: Effects of litter types on organoleptic properties of broiler meat

Organoleptic Properties	Sex	Experiment I			Experiment II			Experiment III		
		Litter types								
		FL-I	UL-I	ML-I	FL-II	UL-II	ML-II	FL-III	UL-III	ML-III
Tenderness	Male	6.85 ^a \pm 0.25	6.52 ^a \pm 0.26	6.22 ^a \pm 0.29	6.74 ^a \pm 0.18	6.81 ^a \pm 0.24	6.92 ^a \pm 0.24	6.04 ^a \pm 0.18	7.07 ^a \pm 0.21	6.67 ^a \pm 0.21
	Female	6.70 ^a \pm 0.26	6.52 ^a \pm 0.28	6.81 ^a \pm 0.28	6.74 ^a \pm 0.24	7.00 ^a \pm 0.23	6.85 ^a \pm 0.26	6.52 ^a \pm 0.21	6.70 ^a \pm 0.26	7.18 ^a \pm 0.23
	Mean	6.77 ^a \pm 0.18	6.52 ^a \pm 0.19	6.51 ^a \pm 0.21	6.74 ^a \pm 0.15	6.90 ^a \pm 0.16	6.88 ^a \pm 0.18	6.28 ^a \pm 0.14	6.88 ^b \pm 0.17	6.92 ^b \pm 0.16
Juiciness	Male	6.37 ^a \pm 0.30	6.26 ^a \pm 0.31	6.18 ^a \pm 0.31	6.74 ^a \pm 0.13	6.96 ^a \pm 0.19	6.78 ^a \pm 0.21	6.22 ^a \pm 0.13	7.07 ^a \pm 0.18	6.70 ^a \pm 0.19
	Female	6.48 ^a \pm 0.21	6.15 ^a \pm 0.26	6.37 ^a \pm 0.26	6.78 ^a \pm 0.19	6.81 ^a \pm 0.21	6.92 ^a \pm 0.21	6.48 ^a \pm 0.17	6.59 ^a \pm 0.26	7.07 ^a \pm 0.24
	Mean	6.42 ^a \pm 0.18	6.20 ^a \pm 0.20	6.28 ^a \pm 0.20	6.76 ^a \pm 0.11	6.88 ^a \pm 0.14	6.85 ^a \pm 0.15	6.35 ^a \pm 0.11	6.83 ^b \pm 0.16	6.88 ^b \pm 0.15
Flavour	Male	6.11 ^a \pm 0.31	6.26 ^a \pm 0.26	6.00 ^a \pm 0.35	7.07 ^a \pm 0.15	7.07 ^a \pm 0.16	6.70 ^a \pm 0.21	6.22 ^a \pm 0.14	6.59 ^a \pm 0.14	6.52 ^a \pm 0.22

	Female	6.29a ± 0.27	5.85a ± 0.32	6.07a ± 0.27	6.63a ± 0.15	6.88a ± 0.12	7.07a ± 0.17	6.37a ± 0.15	6.55a ± 0.20	6.63a ± 0.19
	Mean	6.20a ± 0.20	6.05a ± 0.21	6.03a ± 0.22	6.85a ± 0.11	6.97a ± 0.10	6.88a ± 0.14	6.29a ± 0.10	6.57a ± 0.12	6.57a ± 0.15
Overall acceptability	Male	6.41a ± 0.27	6.33a ± 0.28	6.18a ± 0.28	6.85a ± 0.17	6.89a ± 0.15	6.93a ± 0.23	6.41a ± 0.13	6.96a ± 0.16	6.70a ± 0.20
	Female	6.41a ± 0.28	6.15a ± 0.30	6.26a ± 0.26	6.92a ± 0.18	7.11a ± 0.19	6.93a ± 0.18	6.52a ± 0.12	6.55a ± 0.23	6.92a ± 0.22
	Mean	6.41a ± 0.19	6.24a ± 0.20	6.22a ± 0.19	6.88a ± 0.12	7.00a ± 0.12	6.93a ± 0.14	6.46a ± 0.09	6.75a ± 0.14	6.81a ± 0.15

Figures in a row with at least one common superscript do not differ significantly ($P > 0.05$)

Table 4: Results of 't' tests on various organoleptic properties of broiler meat raised on used litter

Criteria	Calculated value of 't'			Averages		
	UL-I vs UL-II	UL-I vs UL-III	UL-II vs UL-III	UL-I	UL-II	UL-III
Tenderness	1.55060 ^{NS}	1.44965 ^{NS}	7.83529 ^{NS}	6.52	6.91	6.89
Juiciness	2.79422 ^{**}	2.45494 [*]	0.25983 ^{NS}	6.20	6.89	6.83
Flavour	4.02026 ^{**}	2.15276 [*]	2.56531 [*]	6.05	6.98	6.57
Overall acceptability	3.21248 ^{**}	2.09248 [*]	1.28874 ^{NS}	6.24	7.00	6.76

NS= Not significant ($P > 0.05$); *= Significant ($P < 0.05$);**= Highly significant ($P < 0.01$)

Conclusions

It was interesting to note that all the organoleptic properties of broiler meat such as tenderness, juiciness, flavour and overall acceptability were improved in UL-II and UL-III as compared to UL-I. Significantly ($P < 0.01$) improvement was observed for juiciness, flavour and overall acceptability of meat in UL-II while the improvement was non-significantly for tenderness. Similar situation could also be noticed in broilers raised on mixed litters where juiciness, flavour and overall acceptability of meat were significantly better ($P < 0.05$ to 0.01) in ML-II and III as compared to ML-I, whereas, the improvement in tenderness was statistically non-significant. The improvement in meat quality observed in both used and mixed types of litter in Experiment II and III in comparison to Experiment I might be due to the beneficial effects of using the twice- and thrice- used litters either as such or mixed with 50 parts of fresh litter.

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