

THE USE OF TRITORDEUM IN BROILER CHICKENS DIET AND ITS EFFECT ON PERFORMANCE PARAMETERS

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ABSTRACT

The aim of the experiment was to investigate tritordeum and its potential use in broiler nutrition. The experiment included 90 broilers of the Ross 308 hybrid, divided into 3 groups with 5 replications each. The broilers were fed with 3 feed mixtures (T0, T5, and T40) containing different proportions of tritordeum for 36 days. Feed mixture T0 was mainly composed of corn, wheat, and soybean meal without tritordeum. Feed mixture T5 contained the same components as mixture T0, but it contained 5% of tritordeum. The feed mixture T40 contained 40% tritordeum. Throughout the entire fattening period, feed consumption and live weight gain were recorded, droppings were collected to determine the digestibility of nutrients. At the end of the experiment, the quality of the carcass was also evaluated. The results of the experiment did not show any significant statistical differences between the feed mixtures in terms of feed consumption, feed conversion, live weight gain, or the yield of main meat parts ($P > 0.05$). However, significant statistical differences were found when

comparing the feed mixtures in terms of nitrogen retention ($P < 0.05$). The highest nitrogen retention was observed in feed mixture T5 (67.96%) and the lowest in feed mixture T0 (65.13%). Research has shown the suitability of using tritordeum grain in the nutrition of broilers without any negative impact on production parameters or health. There is an assumption that a certain proportion of tritordeum in the feed mixture may lead to higher nitrogen retention in the organism. As a crop resistant to warmer and drier conditions, tritordeum could potentially replace some traditional cereals in the future. It is important to continue studying new non-traditional feeds in animal nutrition to determine their impact on the organism.

Keywords: alternative feeds; global warming; nitrogen retention, poultry nutrition; Ross 308

INTRODUCTION

In the current era of climate change, with increasing global temperatures and melting glaciers, it is necessary to search for new crops that would be able to adapt to warmer and drier conditions. Tritordeum is a hybrid of barley (*Hordeum chilense*) and durum wheat (*Triticum durum*) (Ávila *et al.*, 2021) and has the potential to adapt to such conditions – it has increased resistance to drought and diseases (De Caro *et al.*, 2024) such as against Septoria leaf blotch, which is one of the most important diseases of wheat (Ávila *et al.*, 2021). The greater drought and heat during the growing season that supports the formation of carotenoids (lutein, zeaxanthin, antheraxanthin or β -carotene). Research by Paznocht *et al.* (2018) showed the highest carotenoid content of 14 selected wheat, barley and tritordeum genotypes in yellow-grained tritordeum HT 439 (12.16 $\mu\text{g/g}$ dry

weight). Lutein, responsible for the yellow color, was the most contained in tritordeum. At the same time, a high content of carotenoids is also achieved thanks to *Hordeum chilense* (Mattera *et al.*, 2016). Another positive feature of tritordeum is a higher ability to bind nitrogen from the soil compared to wheat (Martín *et al.*, 1999). To the best of our knowledge, no scientific study has been published to investigate the effect of tritordeum on the production parameters of broiler chickens.

MATERIAL AND METHODS

Animals and experimental conditions

In the experiment, 90 Ross 308 hybrid roosters were used, which were fed for 36 days. The broilers were divided into 3 groups with 5 repetitions each. So, there were 30 individuals in each group. The chicks were housed in balance cages and the stable conditions were set according to the technological instructions of the Aviagen company for Ross 308. During the experiment, the average daily temperature was 24.88°C and the average humidity was 42.48%. Breeding technology corresponded to Decree No. 208/2004 Coll., on minimum standards for the protection of farm animals against cruelty. The chickens had unlimited access to feed and drinking water throughout the experiment. Feed consumption was recorded every day and droppings were collected over 8 days (120 samples in total) to determine nutrient digestibility. The droppings were stored at -20 °C and subsequently lyophilized and subjected to laboratory analyses. The fattened broilers were weighed every day. The experiment was terminated by decapitation of the broilers, followed by the obtained carcasses. These carcasses, i.e. bodies without tarsometatarsus, giblets and necks, were

weighed and the percentage of the carcass from the live weight of the broilers was calculated.

10 chickens from each group were selected, from which the thigh and breast muscles were dissected and the percentage share of thigh and breast muscle from live weight was determined through calculation.

Feed mixtures

The feed mixtures were compiled according to the nutritional specifications for Ross 308 broilers (Aviagen Group, 2019b). Each group of broilers was fed a feed mixture with a different proportion of tritordeum. Tritordeum variety JB1 samples were taken and subjected to chemical analysis. The results of the chemical analysis are shown in Table 1. The first group (T0) did not contain the proportion of tritordeum, wheat was used instead. Group T5 contained 5% tritordeum and group T40 contained 40% tritordeum. The specific composition of the feed mixtures is documented in Table 2. To determine the digestibility of nutrients using indicator methods, 0.3% chromium oxide indicator (Cr_2O_3) was mixed into the feed mixtures. During the experiment, the mixture BR1 was used, which was fed to the chickens until the 10th day of age. BR2 mixture was fed from day 11 to day 36, when the experiment was terminated.

Table 1. Chemical composition of tritordeum (88% dry matter)

CP	EE	CF	ADF	NDF	Starch	Ash	Carotenoids
%	%	%	%	%	%	%	µg/g
20.28	2.00	1.54	3.53	13.14	50.67	2.47	12.21

CP - crude protein, EE - ether extract, CF - crude fiber, ADF - acid detergent fiber, NDF - neutral detergent fiber

Samples of feed BR1 T0, T5, T40 and BR2 T0, T5, T40 were also taken for chemical analysis. The results of the chemical analysis (calculated on a dry matter basis of 88%) are presented in Table 3.

Table 2. Composition of feed mixtures

Component	Feed mixture BR1			Feed mixture BR2		
	T0	T5	T40	T0	T5	T40
Maize (%)	32.82	42.70	20.69	36.29	48.30	27.03
Wheat (%)	13.00	0.00	0.00	15.62	0.00	0.00
Soybean ex. meal (%)	44.21	43.50	30.00	39.50	38.75	25.00
Rapeseed oil (%)	5.00	4.35	4.10	4.10	3.50	3.00
Wheat gluten (%)	0.15	0.10	0.65	0.05	0.00	0.64
Premix (%)	3.00	3.00	3.00	3.00	3.00	3.00
Monocalcium phosphate (%)	0.77	0.60	0.56	0.59	0.60	0.52
Methionine (%)	0.20	0.00	0.00	0.15	0.15	0.15
Ground limestone (%)	0.56	0.45	0.70	0.40	0.40	0.60
Chromium oxide (%)	0.30	0.30	0.30	0.30	0.30	0.30
Tritordeum (%)	0.00	5.00	40.00	0.00	5.00	40.00

Table 3. Chemical composition of feed mixtures (88% dry matter)

Feed mixtures	CP %	EE %	CF %	Ash %
BR1 T0	23.95	6.65	3.74	6.72
BR1 T5	24.00	6.84	4.31	6.76
BR1 T40	22.87	6.24	3.47	6.59
BR2 T0	22.08	5.82	2.48	6.11
BR2 T5	22.02	5.66	2.48	6.14
BR2 T40	22.08	4.80	2.05	5.53

CP - crude protein, EE - ether extract, CF - crude fiber

The data was processed in Microsoft Excel (USA) and StatSoft Statistica version 12.0 (USA) software. One-way analysis of variance (ANOVA) was used. Scheffé's test was used to determine the difference, with a significance level of $P < 0.05$ considered as a statistically significant difference.

RESULTS AND DISCUSSION

The mean live weights of broilers on the day of the start and the day of the end of the experiment (1st and 36th day), average chick gains, feed consumption and feed conversion are shown in Table 4. Only 88 broilers are included in the results, as 2 broilers from the T5 group they died during the experiment. No significant statistical differences ($P > 0.05$) were found in any of the mentioned parameters between the groups fed with different feed mixtures. The average live weight of broilers on the 36th day of fattening was 2,105.51 g, while according to Aviagen's technological instructions, the given broiler roosters should

weigh 2,332 g (Aviagen group, 2019a). According to the technological instructions (Aviagen group, 2019a), the chicken feed consumption should be 3,480 g, while the lowest chicken feed consumption was 3,027.24 g for the T5 group. Furthermore, the technological instructions (Aviagen group, 2019a) state that the 36th day of fattening should have been a feed conversion of 1.492, with the lowest feed conversion in the experiment being 1.43 for the T5 group. According to the results, it can be inferred that adding tritordeum to the feed ration does not reduce the production parameters of broilers and it is possible to use this cereal.

Table 4. Average live weight, average live weight gains, feed consumption and conversion

n	In total 88	T0 30	T5 28	T40 30
	mean ± standard deviation			
ALW of chickens at the beginning of the experiment (g)	43.93 ± 3.63	44.13 ± 3.63	43.86 ± 3.87	43.80 ± 3.52
ALW of chickens on the 36th day of the experiment (g)	2105.51 ± 312.33	2123.60 ± 338.01	2101.07 ± 326.37	2091.57 ± 280.48
AFC per chicken per day (g)	87.40 ± 6.75	88.75 ± 8.56	84.09 ± 2.52	89.37 ± 7.67
FCR per trial period per cage	1.49 ± 0.11	1.50 ± 0.14	1.43 ± 0.05	1.53 ± 0.10

n - number of cases, *ALW* – average live weight, *AWG* - average weight gain, *AFC* - average feed consumption, *FCR* – feed conversion ratio

Table 5 shows the yields of the main meaty parts of slaughtered chickens. A total of 30 chickens, 10 individuals from each group, were included in this section. The obtained data were subjected to the Scheffé test, which showed no statistically significant differences ($P > 0.05$). Aviagen's technological manual (Aviagen group, 2019a) states that at a live weight of 2,400 g, the carcass yield should be 72.97%, while the highest yield was achieved in the T5 group at 70.03%. Stupka *et al.* (2013) states that the average slaughter yield in chickens is 70 to 76%, which would approximately correspond to the results of the experiment. As for the yield of breast and thigh muscle, according to the technological instructions (Aviagen group, 2019a), it should be 24.03% and 12.88% at a live weight of chickens of 2,400 g. The highest average pectoral muscle yield was measured in the T5 group at 23.22% and the highest average thigh muscle yield was measured in the T40 group at 15.72%. When compared, it is clear that the results of the experiment correspond to the standards for the given hybrid. Another part of this experiment was to clarify the influence of the proportion of tritordeum in the feed ration for broilers on the retention of nitrogenous substances. The data that was collected through faecal sampling and subsequent chemical analysis was evaluated by Scheffé test and the results showed the demonstration of statistically significant differences ($P < 0.05$). In group T5, the highest retention of nitrogenous substances was measured at 67.96%, while the lowest was found in the control group T0, where the retention of nitrogenous substances was measured at 65.13%.

Table 5. Yields of the main meaty parts of slaughtered chickens

	T0	T5	T40
n	10	10	10
mean ± standard deviation			
Average live weight of chickens (g)	2421.20 ± 239.70	2284.40 ± 348.03	2302.60 ± 287.09
Average carcass yield (g)	1668.48 ± 188.54	1596.80 ± 230.98	1596.41 ± 224.43
Average carcass yield (%)	68.85 ± 1.71	70.03 ± 2.78	69.23 ± 2.09
Average breast meat yield from carcass (%)	33.03 ± 2.83	33.09 ± 2.59	31.73 ± 2.34
Average thigh meat yield from carcass (%)	21.58 ± 1.86	22.33 ± 1.51	22.72 ± 1.78

n – number of cases

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be predicted that a certain proportion of tritordeum increases the retention of nitrogenous substances, which is important both from an economic and ecological point of view.

Table 6. Nitrogen retention

n	T0	T5	T40
	40	40	40
	mean $\pm$ standard deviation		
Nitrogen	65.13	67.96	67.10
retention (%)	$\pm$	$\pm$	$\pm$
	5.44 ^a	3.73 ^b	0.83 ^{ab}

a, b means statistically significant differences ($P < 0.05$); n – number of cases

CONCLUSION

This study did not show a negative effect of tritordeum on the production parameters of broilers or on the quality of the carcass and the main meaty parts. However, a statistically significant difference ($P < 0.05$) was found in the retention of nitrogenous substances between groups T0 and T5. In group T5, which was fed a feed mixture with a proportion of 5% tritordeum, the highest retention of nitrogenous substances was measured at 67.96%. From this, we can conclude that the use of tritordeum in feed mixtures for broiler chickens is feasible as it does not have a negative effect on zootechnical and processing parameters, while a certain proportion of tritordeum can increase the retention of nitrogenous substances. This can reduce costs in the production of compound feed, as the need for these nutrients will be reduced. At the same time, an increase in the retention of nitrogenous substances means less nitrogenous substances excreted in the feces, which has a positive impact on the environment. However, it is important to continue similar research and clarify other effects on the

production and health parameters of farm animals, as well as on the environment.

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