

INSECT MEAL IN THE BROILER CHICKEN DIETS

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ABSTRACT

Insects are increasingly being investigated as a promising source of protein with high nutritional value. The aim of this study was to evaluate growth performance, carcass characteristics and nitrogen retention coefficient in chickens fed insect meal. Chickens were divided into four groups: Control group (without insect meal), three groups receiving diets containing 5%, 15%, 30% inclusion of black soldier larvae meal. The 30% inclusion of insect meal in diets showed negative effects on all monitored parameters (body weight, feed conversion ratio, carcass yield, thigh yields and nitrogen retention coefficient).

Keywords: poultry nutrition; black soldier fly; growth; carcass; nitrogen retention

INTRODUCTION

The growing demand for animal products has increased interest in alternative protein sources for livestock nutrition (Makkar et al., 2014). Traditionally, soybean meal (SBM) and fish meal (FM) have been among the most commonly used protein feeds in poultry nutrition (Sánchez-Muros et al., 2014). However, these feeds are largely dependent on imports and are associated with economic and environmental impacts (Makkar et al., 2014). For these reasons, measures have been implemented to promote the use of alternative protein sources. The European Union has authorized several insect species for inclusion in poultry and pig diets.

Generally, insects are rich sources of protein and lipids (Makkar et al., 2014). However, insects contain chitin, which may be more difficult to digest for non-ruminants (Sánchez-Muros et al., 2014). Nutrient composition and chitin content vary according to insect species, developmental stage, diet and processing method (van Huis et al., 2013).

Several studies have evaluated insect meal in broiler diets, but results remain inconsistent. Several authors reported maintained or improved growth performance, feed conversion ratio (FCR), and carcass traits following partial replacement



of SBM or FM (Bovera et al., 2015; Dabbou et al., 2018). In contrast, other studies observed negative effects on growth performance, FCR and carcass characteristics (Šťastník et al., 2021; Hartinger et al., 2021).

The aim of this study was evaluated performance parameters and nitrogen retention.

MATERIAL AND METHODS

Animals, experimental conditions and diets

The experiment was conducted at the accredited experimental facilities of Mendel University in Brno. A total of 96 one-day-old male broiler chickens of hybrid combination Ross 308 were divided into four groups, each with four replicates. The trial lasted for 35 days. The lighting program, temperature and humidity was set according to the technological instruction for hybrid combination. Four diets were fed: Control (without insect meal, "IM0"), and three experimental diets receiving inclusion of black soldier fly larvae meal (5% "IM5", 15% "IM15" and 30% "IM30") as a partial substitute of SBM. The experimental diets were prepared by Tekro, spol., s.r.o. and were balanced so that the compared diets corresponded in their basic nutritional composition (particularly in crude protein, crude fat, crude fibre, and energy content). During the first 14 days, the chickens were fed experimental starter diets, followed by grower diets, and finally finisher diets, which were fed during the last week. During the experiment, the chickens had unlimited access to feed and water.

Sample collection

During the experiment, feed consumption was recorded daily and FCR was subsequently calculated. The chickens were weighed every week to determine growth curves. At the end of the experiment, the chickens were weighed and slaughtered.

Slaughter performance parameters were evaluated in selected average individuals (eight individuals from each group). Among the slaughter performance parameters carcass yield was evaluate. Breast and thigh were weighed, and the proportion of the muscle parts was determined.

Nitrogen retention was determined using the indicator method with chromium oxide (Cr_2O_3) added to the experimental diets. Excreta samples were collected at regular intervals throughout the experimental period. A detailed description of the methodology is provided by Šťastník et al. (2025).

Statistical analysis

The data were processed by Microsoft Excel (USA) and TIBCO Statistica version 14.0 (USA). A one-way analysis of variance (ANOVA) and Scheffé's test were used to determine statistically differences between groups. The value $P < 0.05$ was regarded as a statistically significant difference.

RESULTS AND DISCUSSION

Figure 1 shows changes in the average body weight of broiler chickens during the experiment. The IM30 group had significantly lower body weight from 14 days of age to the end of the experiment compared with other groups. At the end of the experiment, the IM0, IM5, IM15 groups had weight around 2 kg. Chicken growth could have been limited by the chitin content present in insect meal. Even relatively low inclusion levels (2% and 5%) of mealworm meal reduced the body weight of broilers; however, the final body weight still exceeded 2 kg (Šťastník et al., 2021). Similarly, Facey et al. (2023) observed a decrease in broiler body weight with increasing replacement of SBM by black soldier fly larvae meal. In contrast, Dabbou et al. (2018) reported an opposite trend, with broiler body weight increasing as the inclusion level of black soldier fly larvae meal in the diet increased. Bovera et al. (2015) found out no effect of complete replacement of SBM with mealworm meal on broiler body weight.

In Table 1 is shown the feed intakes and FCR, which were influenced by inclusion of insect meal in diets. In starter, grower and finisher phases and overall, the IM30 group had lower feed intake than other groups. Due to its reduced feed intake, the IM30 group showed a significantly higher FCR in all phases of the fattening period except the finisher phase, during which no significant differences were observed between groups. Facey et al. (2023) also observed lower feed intake and higher FCR in groups fed diets containing black soldier fly larvae meal. Bovera et al. (2015) observed a positive effect of mealworm meal on FCR.

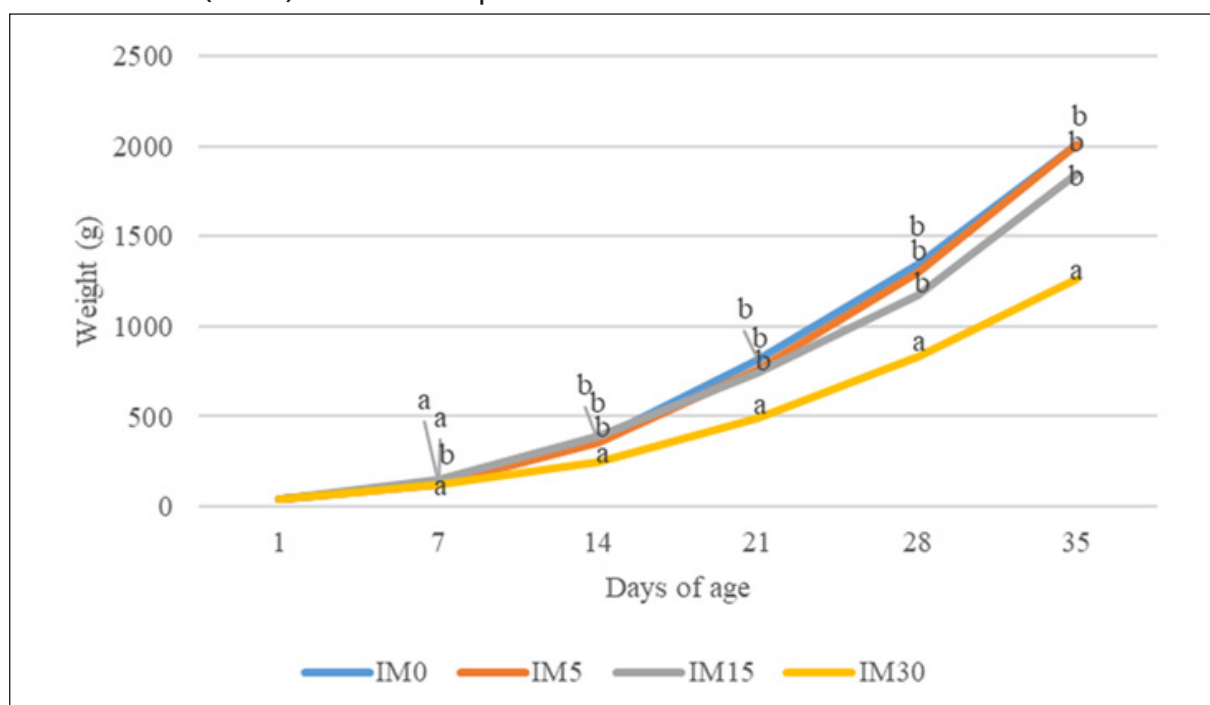


Fig. 1: Changes in the average body weight of chickens during the experiment

a, b – means statistically significant differences ($P < 0.05$); IM0 – Control (without insect meal); IM5 – 5% inclusion of insect meal in diet; IM15 – 15% inclusion of insect meal in the diet; IM30 – 30% inclusion of insect meal in the diet.

Tab. 1: Average feed intake and FCR during experiment

	Phases	IM0	IM5	IM15	IM30
Feed intake (g/bird/period)	Starter	436 ^b	379 ^b	413 ^b	297 ^a
	Grower	1440 ^c	1359 ^{bc}	1296 ^b	1010 ^a
	Finisher	1335 ^b	1300 ^b	1336 ^b	1015 ^a
	Overall	3211 ^b	3037 ^b	3045 ^b	2323 ^a
Feed intake (g/bird/day)	Starter	31 ^b	27 ^b	29 ^b	21 ^a
	Grower	103 ^c	97 ^{bc}	93 ^b	72 ^a
	Finisher	191 ^b	186 ^b	191 ^b	145 ^a
	Overall	92 ^b	87 ^b	87 ^b	66 ^a
FCR	Starter	1.33 ^{ab}	1.20 ^a	1.17 ^a	1.43 ^b
	Grower	1.48 ^a	1.44 ^a	1.66 ^{ab}	1.75 ^b
	Finisher	2.01	1.83	2.05	2.40
	Overall	1.63 ^{ab}	1.54 ^a	1.69 ^{ab}	1.92 ^b

^{a, b, c} – in row means statistically significant differences ($P < 0.05$); FCR – feed conversion ratio; IM0 – Control (without insect meal); IM5 – 5% inclusion of insect meal in the diet; IM15 – 15% inclusion of insect meal in the diet; IM30 – 30% inclusion of insect meal in the diet.

The results presented in Table 2 for the nitrogen retention coefficient °of finisher diets are consistent with the previously discussed findings. The nitrogen retention coefficient was lowest in the IM30 group compared with other groups. These findings further support the negative impact of the treatment on broiler performance. Chitin may be reason for this negative effect. The negative effect of mealworm meal on the ileal digestibility coefficient of crude protein was reported by Bovera et al. (2016). In contrast, Dalmoro et al. (2021) observed an increasing ileal nitrogen digestibility coefficient in broilers receiving diets containing mealworm meal.

Tab. 2: Nitrogen retention coefficient of finisher diets

	IM0	IM5	IM15	IM30
n	8	8	8	8
Nitrogen retention (%)	56.46 ^b	54.63 ^b	52.11 ^b	36.86 ^a

^{a, b} – in row means statistically significant differences ($P < 0.05$); n – number of cases; IM0 – Control (without insect meal); IM5 – 5% inclusion of insect meal in the diet; IM15 – 15% inclusion of insect meal in the diet; IM30 – 30% inclusion of insect meal in the diet.

Table 3 shows slaughter performance parameters of selected broiler chickens. The differences were found out in carcass yield and thigh yields. In these parameters, the IM30 had lower values than other groups. Only breast yields were not affected by inclusion of insect meal. Hartinger et al. (2021) observed tendency toward lower carcass yield in broilers fed diets containing 100 g/kg of black soldier fly larvae meal. Dörper et al. (2024) observed no effects of insect-derived feed ingredients on slaughter performance parameters.

Tab. 3: Slaughter performance parameters

	IM0	IM5	IM15	IM30
n	8	8	8	8
Body weight (g)	1974 ^b	1909 ^b	1951 ^b	1518 ^a
Carcass yield (%)	67.95 ^b	69.34 ^b	68.58 ^b	64.08 ^a
Breast yield (% of BW)	16.53	18.14	17.45	18.12
Breast yield (% of CW)	24.32	26.15	25.44	28.45
Thigh yield (% of BW)	15.71 ^b	15.92 ^b	15.60 ^b	13.66 ^a
Thigh yield (% of CW)	23.12 ^b	22.96 ^{ab}	22.76 ^{ab}	21.33 ^a

^{a, b} – in row means statistically significant differences ($P < 0.05$); n – number of cases; BW – body weight; CW – carcass weight; IM0 – Control (without insect meal); IM5 – 5% inclusion of insect meal in the diet; IM15 – 15% inclusion of insect meal in the diet; IM30 – 30% inclusion of insect meal in the diet.

CONCLUSION

Insect meal is widely considered a promising alternative protein source that can partially replace conventional protein feeds due to its high crude protein content and the rapid growth cycle of insects. The present results indicate that higher dietary inclusion level of insect meal impair broiler growth performance, increase FCR, and reduce carcass yield. These findings are further supported by decreased nitrogen retention coefficient.

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