RESEARCH ARTICLE

Impact of Lemongrass and Peppermint Essential Oils Supplementation on the Growth Performance and Carcass Traits of Japanese Quails

Siddhartha Srivastava[1], Jyoti Palod[2]*, Rabendra K. Sharma[3], Shive Kumar[4], Anita[5], Ripusudan Kumar[6], Manoj K. Singh[7]

Abstract

An experiment was conducted on 150, six-day-old Japanese quails for 5 weeks to study the impact of lemongrass and peppermint essential oils supplementation on the growth performance and carcass traits. Experimental Japanese quail chicks were randomly allocated into 5 different treatment groups (T_0, T_1, T_2, T_3 and T_4) with three replicates of 10 chicks each. Different treatment groups were supplemented with essential oils, viz. T_0 control basal diet (no essential oil), T_1 0.1% lemongrass essential oil, T_2 0.1% peppermint essential oil, T_3 0.05% lemongrass + 0.05% peppermint essential oils, and T_4 0.1% lemongrass + 0.1% peppermint essential oils in the feed. The influence of lemongrass and peppermint essential oils supplementation on body weight gain (BWG), feed intake (FI), feed conversion ratio (FCR), performance index, the protein efficiency ratio (PER), production efficiency factor, and carcass characteristics were assessed during the experiment. Results indicated that the inclusion of lemongrass and peppermint essential oils increased body weight gain, reduced feed intake, improved feed conversion ratio, performance index, protein efficiency ratio, and production efficiency factor, with best performance during all the periods was noted in the T_3 group. Lemongrass and peppermint essential oils at 0.05% each in combination significantly ($p < 0.05$) improved dressed yield with and without giblets, cut-up parts in terms of thighs, breast, drumsticks, wing weights, weights of heart, gizzard, and giblets. In any treatment group, the liver weight and processing losses were not significantly affected by lemongrass and peppermint essential oils supplementation.

Keywords: Carcass traits, Growth performance, Japanese quails, Lemongrass essential oil, Peppermint essential oil.

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Introduction

The poultry sector in India has emerged amongst the most vibrant and diversified sectors. In last few decades, the poultry industry has made tremendous growth and is emerging as a sunrise sector with an overall growth rate of around 10 to 12% and specifically 8.51 and 7.52 % in egg and broiler production, respectively (Basic Animal Husbandry Statistics, 2019) as against 2.5% for crops (Economic Survey, 2019-20). The poultry sector contributes nearly 0.57% of the national GDP and about 16 % of the livestock GDP. The total poultry population has seen an overall increase of 16.80%, and currently, it is 851.81 million, while there is an increase of 4.50% in the commercial poultry population which is now 534.74 million (Livestock Census, 2019).

Due to the excessive and discriminant use of antibiotics in poultry and subsequent development of bacteria resistant to various antibiotics, there is a necessity to explore alternatives to antibiotics. As compared to synthetic antibiotic growth promoters, essential oils show less toxicity and are without any residues hence promising animal welfare and food security (Gong *et al.,* 2014). Essential oils in the poultry feed are used due to their antiparasitic, antifungal, antimicrobial, and antiviral properties and are also known to accelerate antibody production with an increase in the number of

[1-4,7]Department of Livestock Production Management, College of Veterinary Sciences and Animal Husbandry, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand, India.

[5]Department of Livestock Products Technology, College of Veterinary Sciences and Animal Husbandry, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand, India.

[6]Department of Animal Nutrition, College of Veterinary Sciences and Animal Husbandry, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand, India.

Corresponding Author: Jyoti Palod, Department of Livestock Production Management, College of Veterinary Sciences and Animal Husbandry, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand, India, e-mail: palod_jyoti17@rediffmail.com

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heterophils and macrophages, faster recovery (healing) of the liver after injury, and beneficial effects on the intestinal morphology and better intestinal repair after diarrhea (Sandner *et al.,* 2020). The present investigation was carried out to acknowledge the limitations of antibiotics growth promoters and the benefits of lemongrass (Cymbopogon citratus) and peppermint (Mentha piperita) essential oils potential essential oils on growth performance and various carcass traits of Japanese quails.

Materials and Methods

Following approval of the Institutional Animal Ethical Committee (IAEC) of GBPUA&T, Pantnagar, a total of 150 six-day-old commercial Japanese quail birds were procured from Central Avian Research Institute (CARI), Izatnagar, Bareilly (UP). All the birds were individually weighed and randomly allocated into five dietary treatment groups, each contained 3 replicates of 10 Japanese quails. Quail chicks were placed in five treatment groups, *viz.*, T_0, control basal diet (no essential oil), T_1, 0.1% lemongrass essential oil, T_2, 0.1% peppermint essential oil, T_3, 0.05% lemongrass + 0.05% peppermint essential oils, and T_4, 0.1% lemongrass + 0.1% peppermint essential oils in feed.

Lemongrass and peppermint essential oils were purchased from CSIR-Central Institute of Medicinal & Aromatic Plants, Pantnagar (U.S. Nagar), Uttarakhand. A feeding trial of five weeks duration was conducted in which lemongrass and peppermint essential oils were supplemented through a feed to different treatment groups of Japanese quails. Birds were fed *ad libitum* in starter (I-II week) and finisher (III-V week) periods. Throughout 35-day experiment, the birds were provided fresh drinking water *ad libitum* under a battery cage system. All the housing and management conditions provided were similar for chicks of different treatment groups. Bodyweight (BW) at zero-days and weekly intervals were recorded for up to 35 days. Feed consumption (FI) of chicks in each group was calculated on the replicate basis at weekly intervals for five weeks and from these data, body weight gain (BWG), feed conversion ratio (FCR), performance index (PI), protein efficiency ratio (PER) and production efficiency factor (PEF) were calculated. At the end of the experiment, two birds from each replicate were slaughtered. Different carcass parameters like dressed weight (with or without giblets), cut-up yield (thighs, drumstick, wings, breast and neck weights), heart, liver, gizzard weight, and processing losses (blood loss, feathering loss, head, shank, and abdominal fat) were determined. The design of the experiment used was a completely randomized design using one-way ANOVA and means of different dietary treatments were compared with Tukey's test. The p-value less than 0.05 was considered significant (Snedecor and Cochron, 1994).

Results and Discussion

Growth Performance

Data relating to the growth performance of birds in terms of FI, BWG, FCR, PI, PER, and PEF are presented in Table 1. Japanese quails supplemented with lemongrass and peppermint essential oils had significantly ($p < 0.01$) higher BWG and lower feed intake (FI) in comparison to the control group with the most increased mean BW and lowest mean FI observed in the group supplemented with a combination of 0.05% lemongrass and peppermint essential oils each. FCR and PER of quails supplemented with a combination of lemongrass and peppermint essential oils at different concentrations showed better and improved results over control and other single oil treatment groups. However, during the overall experimental period, significantly ($p < 0.01$) lowest FCR and highest PER were noted in quails supplemented with 0.05% lemongrass and 0.05% peppermint in combination, followed by the supplementation at 0.1% concentration each in combination. The performance index was found to be significantly ($p < 0.01$) higher in the lemongrass and peppermint essential oils mixture at 0.05% concentration of each. As regards production efficiency factor (PEF), Japanese quails supplemented with these essential oils showed significant improvement. Quails of lemongrass and peppermint essential oils supplemented groups had significantly ($p < 0.01$) different PEF among themselves, with the best production efficiency factor, observed in the group supplemented with a blend of lemongrass and peppermint essential oils at 0.05% concentration each.

Table 1: Growth performance of Japanese quails supplemented with lemongrass and peppermint essential oils in the diet

Treatment groups	*Initial BW*	*Final BW*	*BW gain*	*Feed intake*	*FCR*	*Performance index*	*PER**	*PEF***
T_0	23.54	223.30^{e}	199.76^{e}	693.16^{a}	3.47^{a}	57.58^{e}	1.214^{e}	18.38^{e}
T_1	24.27	235.21^{c}	210.94^{c}	662.91^{b}	3.14^{c}	67.12^{c}	1.341^{c}	21.38^{c}
T_2	24.41	227.83^{d}	203.42^{d}	668.54^{b}	3.29^{b}	61.90^{d}	1.283^{d}	19.80^{d}
T_3	24.57	249.87^{a}	225.30^{a}	636.96^{c}	2.83^{e}	79.70^{a}	1.494^{a}	25.25^{a}
T_4	24.67	240.84^{b}	216.17^{b}	663.03^{b}	3.07^{d}	70.48^{b}	1.374^{b}	22.44^{b}
SEM	0.200	4.709	0.602	1.616	0.014	0.446	0.014	0.124
p-value	0.455	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Means with different superscripts in a row between groups differ significantly ($p < 0.01$).
*Protein efficiency ratio; ** Production efficiency factor.

Table 2: Carcass traits of Japanese quails supplemented with lemongrass and peppermint essential oils in the diet

Treatments	*Dressed weight (with giblets)*	*Dressed weight (without giblets)*	*Heart weight*	*Gizzard weight*	*Giblets*
T_0	73.31^{c}	67.46^{c}	0.76^{bc}	2.71^{b}	5.85^{c}
T_1	74.67^{bc}	68.69^{abc}	0.70^{c}	2.79^{b}	5.98^{bc}
T_2	74.02^{bc}	67.90^{bc}	0.82^{ab}	2.83^{ab}	6.12^{abc}
T_3	76.74^{a}	70.50^{a}	0.86^{a}	2.86^{ab}	6.24^{ab}
T_4	75.66^{ab}	69.33^{ab}	0.84^{ab}	2.96^{a}	6.34^{a}
SEM	0.644	0.610	0.036	0.048	0.102
p-value	< 0.01	< 0.05	< 0.05	< 0.05	< 0.05

Means with different superscripts in a row between groups differ significantly ($p < 0.01$; $p < 0.05$).

Table 3: Carcass traits (cut-up parts) of Japanese quails supplemented with lemongrass and peppermint essential oils in the diet

Treatments	*Thighs*	*Breast*	*Drumstick*	*Back*	*Neck*	*Wing*
T_0	9.76^{bc}	24.57^{c}	5.85^{b}	22.03	3.08	5.66^{b}
T_1	9.92^{ab}	24.98^{bc}	5.98^{ab}	22.22	3.11	5.82^{ab}
T_2	9.49^{c}	25.45^{ab}	6.11^{ab}	22.43	3.12	5.89^{a}
T_3	10.11^{a}	25.60^{a}	6.16^{a}	22.08	3.17	5.94^{a}
T_4	9.79^{b}	25.19^{ab}	6.24^{a}	22.33	3.07	5.93^{a}
SEM	0.092	0.202	0.074	0.222	0.030	0.060
p-value	< 0.05	< 0.01	< 0.05	> 0.05	> 0.05	< 0.05

Means with different superscripts in a row between groups differ significantly ($p < 0.01$, $p < 0.05$).

The findings of present investigation with regards to better BW and BWG in lemongrass and peppermint essential oils supplemented groups corroborated with Sorour *et al.* (2021) and Linh *et al.* (2020), who noted a significant increase in body weight gain in broilers and pekin ducks provided with peppermint essential oil and lemongrass, respectively. Similarly, Asadi *et al.* (2017) and Mukhtar *et al.* (2013) reported an increase in body weight gain in peppermint powder and lemongrass essential oil (over control) supplementation, respectively, in broilers. Parade *et al.* (2019) found significant decrease in feed consumption in broilers supplemented with 1.5% lemongrass leaf meal. Similarly, Gole *et al.* (2018) found lower cumulative feed intake in peppermint essential oil supplemented broilers than control group. John (2020) also reported significant effect on FCR due to lemongrass essential oil in broilers. Linh *et al.* (2020) observed better feed conversion ratio in ducks supplemented with increasing levels of lemongrass extract, and Al-kassie (2010) in broilers fed with peppermint supplementation. The improvement in various growth performance indices might be due to an increase in intestinal villous surface area allowing for better absorption and utilization of nutrients along with decrease in various GI disorders. These essential oils are also known to improve endogenous digestive enzymes profile and thereby better the metabolism of nutrients (Sandner *et al.,* 2020).

Carcass Traits

The impact of lemongrass and peppermint essential oils supplementation on carcass traits in Japanese quails is given in Tables 2 and 3. The dressed yield with giblets of Japanese quails in the lemongrass and peppermint essential oils supplemented group was significantly ($p < 0.01$) higher than in control. However, the best results were obtained in quails fed with a mixture of lemongrass and peppermint essential oils at 0.05% concentration each. No impact of lemongrass and peppermint essential oils supplementation either single or in combination was seen on dressed yield without giblets amongst treatment groups, but it was significantly ($p < 0.05$) higher in supplemented groups relative to control. Weight of breast, drumstick, and wings showed significant ($p < 0.05$) improvement in lemongrass and peppermint essential oils supplemented groups over control. However, thighs weight was significantly ($p < 0.05$) higher in quails fed with a mixture of lemongrass and peppermint essential oils at 0.05% level. Neck and back were insignificantly ($p > 0.05$) affected by lemongrass and peppermint essential oils supplements (Tables 2 and 3).

Weights of heart, gizzard, and giblets in lemongrass and peppermint essential oils had improved over the control and T_1 group. Processing losses (blood, feather, shank, head, and abdominal fat) showed insignificant ($p > 0.05$) differences among each other. These observations agreed with the findings of Asadi *et al.* (2017), who found a significant increase in dressing percentage (with giblets) in peppermint powder supplemented broilers. Khattak *et al.* (2014) found a significant increase in breast and thighs weight with supplementation of Tecnaroma (essential oil blend) in broilers. However, Alzawqari *et al.* (2016) and Azevedo *et al.* (2017) found an insignificant ($p > 0.05$) effect on thighs, drumstick, and breast weight in sweet orange and lemongrass leaves extracts, and *Lippia rotundifolia* and lemongrass essential oil fed Japanese quails, respectively. Ahmed *et al.* (2016) found significantly ($p < 0.05$) higher gizzard weight in peppermint leaves

extract supplemented broilers. However, Alagawany *et al.* (2021) found no significant influence of lemongrass essential oil on dressing yield in Japanese quails.

Conclusions

Dietary supplementation of lemongrass and peppermint essential oils at 0.05% each in combination improved Japanese quails' growth performance and carcass characteristics. Henceforth, it may be advised to supplement a mixture of 0.05% each of lemongrass essential oil and peppermint essential oils in a feed of Japanese quails for improved growth performance and carcass characteristics.

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