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Impact of dietary supplementation of peppermint and eucalyptus essential oils on nutrient utilization in Japanese quails

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Abstract
The present experiment was carried out to study the impact of dietary supplementation of peppermint and eucalyptus essential oils on nutrient utilization in Japanese quails. A total of 180 Japanese quail chicks were divided into 5 groups with 3 replicates containing 12 birds each. All groups were fed with basal diet. The treatments were as follows: T_0 (control), T_1 (0.2% peppermint essential oil), T_2 (0.2% eucalyptus essential oil), T_3 (0.1% each of peppermint and eucalyptus essential oil) and T_4 (0.05% each of peppermint and eucalyptus essential oil). After 5 weeks of feeding trial, one-week metabolic trial was carried out. Four birds were shifted to metabolic cages. Out of 7 days, first 4 days was given for adaptation followed by 3 days of collection period. The feed and faeces samples were collected and analysed. The results showed that dry matter utilization was significantly (p<0.05) higher in T_1, T_2 and T_3, while the utilization of organic matter and ether extract was significantly (p<0.05) increased in T_1 and T_3. In case of crude protein all the essential oil supplemented groups showed significantly (p<0.05) higher utilization than the control group. Therefore, it can be concluded that the dietary supplementation of peppermint and eucalyptus essential oils in Japanese quails improved the nutrient utilization especially in groups T_1 and T_3.

Keywords: Japanese quails, nutrient utilization, peppermint, and eucalyptus essential oils

1. Introduction
The Livestock products like meat, milk and egg are used by us humans in our day to day life. They are excellent sources of high quality protein with high biological value, essential fatty acids and micronutrients. However, due to the consumption of animal products, the crisis of antimicrobial resistance (AMR) in livestock which is caused by irrational usage of antibiotics in feed pose serious negative influence on human health. The antibiotics were incorporated in livestock sector as feed additives for their metaphylactic, prophylactic and growth promoting benefits. Considering human health, some replacements are being tested which can produce similar effect and at the same time is safe for humans (Alagawany *et al*., 2020) [2]. International and national organizations are striving in this direction so that the overuse or misuse of antibiotics in the livestock production can be completely avoided (Walia *et al*., 2019) [9]. Vitamins, minerals, amino acids, fatty acids, essential oils, polyphenols, herbs, spices, and other nutraceuticals have all been studied in this concern. Numerous essential oils like oregano, cinnamon, peppermint, turmeric, thyme, and lemon have been utilised and tested in livestock as they not only possess therapeutic qualities but also have shown to improve growth, FCR, carcass, and egg production when used in farm animals and poultry (Krishan and Narang, 2014) [6]. This present experiment deals with the use of peppermint (*Mentha piperita*) and eucalyptus (*Eucalyptus globulus*) essential oils as feed supplements. Since both this essential oils are tested in chickens, this experiment was conducted to study the effect of dietary supplementation of peppermint and eucalyptus essential oils on nutrient utilization in Japanese quails.

2. Materials and Methods

The experiment was conducted at Instructional Poultry Farm (I.P.F), Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (U.S. Nagar), Uttarakhand for 5 weeks with CRD (Completely Randomized Design). For this study, 180, six-day old, Japanese quail chicks were divided randomly into five treatment groups each consisting of 36 birds. This treatment groups were further allocated into three replicates each having 12 quail chicks. These birds were reared in battery cages with 24 hrs. Light supply and were given ad libitum access to water. Feeding was done according to different phases: Starter diet (I-II week) and Finisher diet (III-V week). The peppermint and eucalyptus essential oils were provided through feed. The treatments groups were T_0 (control) fed with basal feed without essential oils, T_1 fed with basal feed with 0.2% peppermint essential oil, T_2 fed with basal feed with 0.2% eucalyptus essential oil, T_3 fed with basal feed with 0.1% peppermint essential oil + 0.1% eucalyptus essential oil and T_4 fed with basal feed with 0.05% peppermint essential oil + 0.05% eucalyptus essential oil. As the essential oils are potent, they were incorporated into feed after mixing it with food grade coconut oil which acted as a carrier.

The feeding trial was carried out for 5 weeks where the birds were fed with known quantity of feed and the leftover was weighed. After 5 weeks, 7-day metabolic trial was carried out for which 4 birds (2 males and 2 females) from each replicate were shifted to metabolic cage and were given 4 days of adaptation period followed by 3 days of collection period. The water was given ad libitum. During the adaptation period Japanese quails were given a known quantity of feed and on the next day the feed that is left unconsumed was weighed at around same time. During the period of collection, the amount of feed consumed by the bird at the time of adaptation was calculated and fed to the birds at same time every day for 3 days. It was made sure that the birds were given fresh feed every day. The feces were collected in the galvanized tin trays covered with plastic covers for easy collection. To estimate dry matter, organic matter and ether extract, the feces samples were dried in a hot air oven. For crude protein estimation, feces were stored in 5% sulphuric acid (v/v) and was used later. Proximate analysis of the feed (hot air oven dried) and feces sample was done. Nutrient utilization was determined using the formula:

$$\text{Nutrient utilization (\%)} = \frac{\text{Nutrient intake in feed - Nutrient loss in excreta}}{\text{Nutrient intake in feed}} \times 100$$

All data collected in this study was analyzed using analysis of variance (ANOVA), and any significant differences between treatment means were assessed according to Snedecor and Cochran (1994).

3. Results and Discussions

The results thus obtained were presented in the Table 1

- **Dry matter:** It is the portion of feed that is free from of moisture which indicates the amount of nutrients that is available to the animal. The better the dry matter utilization, more the amount of nutrient absorbed and better growth and performance can be obtained in the birds. In the present trial, the birds belonging to the group T_1 supplemented with 0.2% of peppermint essential oil, T_2 supplemented with 0.2% of eucalyptus essential oil and T_3 which was supplemented with the combination of 0.1% each of peppermint and eucalyptus essential oils showed significantly ($P<0.05$) higher utilization while the significantly ($p<0.05$) minimum utilization was seen in the T_0 (control) group.
- **Organic Matter:** Organic matter represents the dry matter content except the ash component and is expressed as a percentage of dry matter. All the supplemental groups except for T_4 showed better results when compared to T_0 (control). However, T_1 supplemented with 0.2% of peppermint essential oil and T_3 supplemented with combination of 0.1% each of peppermint and eucalyptus essential oils showed significantly ($p<0.05$) higher organic matter utilization.
- **Crude Protein:** Crude Protein is a measurement of protein content of feed which depends on its nitrogen content (CP = N*6.25). The higher the crude protein utilization, greater the amount of protein that will be available for use in animal body. All essential oil supplemented groups showed significantly ($P<0.05$) higher crude protein utilization. The lower utilization was seen in the control (T_0) group.
- **Ether Extract:** Ether extract represents the fat content of a substance. It is also referred to as the crude fat, as it not only includes the true fat but also the pseudo fats. All the essential oil supplemented groups showed better ether extract utilization than the control group. Significantly ($p<0.05$) better results were seen in the group T_1 supplemented with 0.2% peppermint essential oil and T_3 supplemented with combination of 0.1% each of peppermint and eucalyptus essential oils while T_0 showed significantly ($p<0.05$) least utilization.

From the results of this experiment, it can be concluded that the supplementation of peppermint and eucalyptus essential oils had a significant ($p<0.05$) effect on the nutrient utilization of the feed in the Japanese quails especially in the group T_1 supplemented with 0.2% of peppermint essential oil and T_3 which was supplemented with combination of 0.1% each of peppermint and eucalyptus essential oils. The above results are in accordance with Abdel-Waretha and Lohakare (2020) [1] who showed that with the increasing level of peppermint oil supplementation in laying hen, the digestibility of crude protein and ether extract linearly increased. Mohebodini *et al*. (2021) [7] showed that eucalyptus essential oil supplementation in broiler chickens resulted in better Organic Matter and Ether Extract digestibility when compared to control. Emami *et al*. (2012) [3] also found that peppermint essential oil resulted in better Crude Protein digestibility in broilers.

In contrast Khempaka *et al*. (2013) [5] found that the dried peppermint leaves supplementation in broilers did not affect the nutrient digestibility. Kaur *et al*. (2021) [4] also showed that the dietary incorporation of eucalyptus (*Eucalyptus globulus*) leaf powder did not produce a significant variation in the utilization pattern of dry matter, crude protein, ether extract, and organic matter in layers.

Table 1: Influence of dietary inclusion of peppermint and eucalyptus essential oils on nutrient utilization of Japanese quails (Mean ± S.E.)

Treatment	Dry Matter*(%)	Organic Matter*(%)	Crude Protein*(%)	Ether Extract*(%)
T_1	65.63^{a}±0.22	73.91^{a}±0.50	80.78^{a}±0.27	71.69^{a}±0.43
T_2	64.82^{a}±0.23	72.62^{b}±0.30	80.45^{a}±0.45	70.10^{b}±0.36
T_3	65.40^{a}±0.10	73.96^{a}±0.45	80.93^{a}±0.46	71.64^{a}±0.22
T_4	63.56^{b}±0.58	72.30^{bc}±0.17	80.52^{a}±0.21	68.32^{c}±0.32

Within the identical column, values with distinct superscripts differ significantly (*p<0.05)

4. Conclusion
The nutrient utilization of the dry matter, crude protein, organic matter, and ether extract was significantly (p<0.05) increased with dietary supplementation of peppermint and eucalyptus essential oils in Japanese quails especially in the group of birds that was supplemented with 0.2% of peppermint essential oil and combination of 0.1% each of peppermint and eucalyptus essential oils making more nutrient available for birds thus improving its growth and carcass characteristics.

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6. Conflict of Interest
There is no conflict regarding this research

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